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RCRA Facility Investigation – Remedial Investigation/ Corrective Measures Study – Feasibility Study Report for the Rocky Flats Environmental Technology Site Appendix A – Comprehensive Risk Assessment

Volume 15A of 15
Risk Assessment for Wide-Ranging Ecological Receptors

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ACRONYMS AND ABBREVIATIONS

BAF	bioaccumulation factor
bgs	below ground surface
BMP	best management practices
BW	body weight
CAD/ROD	Corrective Action Decision/Record of Decision
CD	Compact disc
CDH	Colorado Department of Health
CDPHE	Colorado Department of Public Health and Environment
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQO	data quality objective
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESL	ecological screening level
HQ	hazard quotient
HRR	Historical Release Report
IAG	Interagency Agreement
ICA	Institutional Control Area
IHSS	Individual Hazardous Substance Site

MaxDL	maximum detection limits
MDC	maximum detected concentration
mg	milligram
mg/day	milligrams per day
mg/kg	milligrams per kilogram
N/A	not applicable
NAS	National Academy of Sciences
NFA	No Further Action
NFAA	No Further Accelerated Action
NOAEL	no observed adverse effect level
OU	Operable Unit
PAC	Potential Area of Concern
QAPjP	Quality Assurance Project Plan
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SCM	Site Conceptual Model
TEQ	toxic equivalent
tESL	threshold ecological screening level
TRV	toxicity reference values
UBC	Under Building Contamination
UCL	upper confidence limit
UT	uncertain toxicity
WRS	Wilcoxon Rank Sum

EXECUTIVE SUMMARY

The risk assessment for wide-ranging ecological receptors evaluates the risk to coyotes and mule deer at the Rocky Flats Environmental Technology Site (RFETS). This risk assessment is based on exposure point concentrations (EPCs) for ecological contaminants of potential concern (ECOPC) that were calculated from surface soil data aggregated across the entire RFETS site.

Wide-ranging receptors of concern that were selected for assessment include representative mammal receptors that would range throughout RFETS. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within RFETS, their potential to come into contact with ecological contaminants of concern (ECOIs), and the amount of life history and behavioral information available.

ECOIs in sitewide surface soil were evaluated in the ECOPC identification process for wide-ranging receptors. Nickel and total dioxins were identified as ECOPCs for selected wide-ranging receptors. These ECOPCs were evaluated further in the risk characterization. Some surface soil dioxin data are for samples collected at approximately 20 feet below ground surface (bgs). The data are classified as surface soil because they are for confirmation samples collected at the bottom of an excavation after an accelerated action soil removal. Although the excavation was backfilled, the data are included in the risk characterization. Sitewide ecological receptors would not be exposed to dioxin in this area.

ECOPC/receptor pairs were evaluated in the risk characterization using a range of EPCs, exposure scenarios, and toxicity reference values (TRVs) to give a range of risk estimates. Overall, no significant risks to wide-ranging ecological receptors that may use the RFETS are predicted. In addition, the high species diversity and continued use of the site by numerous vertebrate species verifies that habitat quality for these species remains acceptable and the ecosystem functions are being maintained. Data collected on wildlife abundance and diversity indicate that wildlife populations are stable and species richness remains high during remediation activities at RFETS.

1.0 INTRODUCTION

The purpose of the Comprehensive Risk Assessment (CRA) is to assess human health and ecological risks[1] posed by contaminants of concern (COCs) remaining at the Rocky Flats Environmental Technology Site (RFETS) following accelerated actions. This report presents the risk assessment for wide-ranging ecological receptors at RFETS. This risk assessment is based on exposure point concentrations (EPCs) for ecological contaminants of potential concern (ECOPC) that were calculated from surface soil data aggregated across the entire RFETS site.

The Ecological Risk Assessment (ERA) methods and selection of receptors are described in detail in the Final CRA Work Plan and Methodology, Revision 1 (DOE 2005a), hereafter referred to as the CRA Methodology. The anticipated future land use of RFETS is a wildlife refuge. A variety of representative terrestrial and aquatic receptors are evaluated in the CRA including the Preble's meadow jumping mouse (PMJM), a federally listed threatened species present at RFETS. The wide-ranging receptors of concern, the coyote and mule deer, were selected for this risk assessment because they are representative mammal receptors that range throughout RFETS. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within RFETS, their potential to come into contact with contaminants, and the amount of life history and behavioral information available.

1.1 Site Description

This section provides a brief description of RFETS, including historical activities, topography, surface water features, vegetation, and ecological resources. A more detailed description of these features and additional information regarding the geology, hydrology, and soil types at RFETS are included in Site Physical Characteristics, Section 2.0 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report).

The Historical Release Report (HRR) (DOE 1992) and its annual updates provide descriptions of known or suspected spills that have occurred since the inception of RFETS. The original HRR organized these known or suspected sources of contamination as Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), or Under Building Contamination (UBC) sites (hereafter collectively referred to as IHSSs) (Figure 1.1). Individual IHSSs and groups of IHSSs were also designated as Operable Units (OUs). Over the course of cleanup under the 1991 Interagency Agreement (IAG) and the 1996 Rocky Flats Cleanup Agreement (RFCA), the U.S. Department of Energy (DOE) has thoroughly investigated and characterized the contamination associated with

[1] The term "risk" in the CRA is used to refer to the combined "lifetime excess cancer risk" and noncarcinogenic health effects assessed using the hazard index (HI) for humans. For ecological receptors, "risk" refers to adverse effects to wildlife populations for non-PMJM receptors or individual PMJM receptors.

these IHSSs. IHSSs have been dispositioned through appropriate remedial actions or by determining that no further accelerated actions (NFAA) are required, pursuant to the applicable IAG and RFCA requirements. Some OUs have also been dispositioned in accordance with an OU-specific Corrective Action Decision/Record of Decision (CAD/ROD). The disposition of the historical IHSSs at RFETS is described in the 2005 Annual Update to the HRR (DOE 2005b), and regulatory agency approval letters are on file. A more detailed description of the IHSS history at RFETS is included in Appendix A, Volume 2, Section 1.0 of the RI/FS Report.

1.1.1 RFETS Description

RFETS is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver. RFETS consists of 6,240 acres, and land around RFETS primarily consists of ranchland, preserved open space, mining areas, and low-density residential areas. RFETS was part of a nationwide nuclear weapons complex owned by DOE. Main fabrication and processing facilities, constructed in 1951, were located near the center of RFETS in what is known as the Industrial Area (IA).

1.1.2 Topography and Surface Water Hydrology

RFETS is located on a broad eastward-sloping plain of coalescing alluvial fans. While the alluvial fan surface west of RFETS has a general slope that falls gently from west to east, more recent geologic processes have incised drainages and removed portions of the alluvial cover and underlying bedrock. Drainage swales passing through RFETS have significant topographical relief (50 to 150 feet) along the eastern portions of the site (Figure 1.1).

Streams and seeps at RFETS are largely ephemeral or intermittent, with stream reaches gaining or losing flow, depending on the season and precipitation amounts. Surface water flow across RFETS is primarily from west to east, with four drainages traversing the site (Figures 1.1 and 1.2):

- Rock Creek – Major drainage in the northwestern part of RFETS. (does not receive runoff from the IA);
- Walnut Creek – Major drainage in the north-central portion of RFETS, including the majority of the IA;
- Woman Creek – Major drainage on the southern side of RFETS, including the southern side of the IA; and
- Smart Ditch – Minor drainage in the far southern section of RFETS (drainage does not receive runoff from the IA).

Even the largest drainages at RFETS typically have defined channels that are relatively narrow, ranging in bottom width from 2 to 10 feet, often with exposed sediments and cobbles, and occasionally with vegetated channels.

Accelerated remedial actions at RFETS resulted in removal of all buildings to at least 3 feet below ground surface (bgs) in the IA except the former east and west vehicle inspection sheds. Other site activities resulted in some surface recontouring and revegetation of the former IA, after removal of parking lots and other surface infrastructure features, as necessary. In addition, ditches and stormwater conveyances have been eliminated or reconfigured to meet objectives for slope stability and stormwater flow, and pavement has been removed.

The removal of buildings and pavement from the IA significantly reduces the volumes and peak discharge rates of runoff from the IA. With accelerated actions complete, it is anticipated that flows in North and South Walnut Creek will be significantly diminished compared with the historic configuration of the site, when buildings and pavement generated additional runoff.

Additional details on topography and surface water hydrology are provided in Section 2.0 of the RI/FS Report.

1.1.3 Flora and Fauna

At an elevation of approximately 6,000 feet above mean sea level, RFETS contains a unique ecotonal mixture of mountain and prairie plant species resulting from the topography of the area and its proximity to the mountain front. The relatively undeveloped RFETS site provides numerous vegetation communities that are used by wildlife to satisfy habitat needs.

Numerous animal species have been observed at RFETS and the more common ones are expected to be present throughout the overall site. Common large and medium-sized mammals likely to live at or frequent RFETs include deer (*Odocoileus hemionus*), coyotes (*Canis latrans*), raccoons (*Procyon lotor*), desert cottontails (*Sylvilagus audubonii*), and white-tailed jackrabbits (*Lepus townsendii*). The most common reptile observed at RFETS is the western prairie rattlesnake (*Crotalis viridus*), and the most common birds include meadow larks (*Sturnella neglecta*) and vesper sparrow (*Pooecetes gramineus*). The most common small mammal species include deer mice (*Peromyscus maniculatus*), prairie voles (*Microtus ochrogaster*), meadow voles (*Microtus pennsylvanicus*), and different species of harvest mice (*Reithrodontomys sp.*). The PMJM is a federally listed threatened species found at RFETS. The preferred habitat for the PMJM is the riparian corridors bordering streams, ponds, and wetlands at RFETS.

More detail on the flora and fauna at RFETS can be found in Section 2.0 of the RI/FS Report.

1.1.4 Data Description

Data have been collected at RFETS under regulatory agency-approved Work Plans, Sampling and Analysis Plans (SAPs), and Quality Assurance Project Plans (QAPjPs) to meet data quality objectives (DQOs) and appropriate U.S. Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE)

guidance. Surface soil, subsurface soil, sediment, surface water, and groundwater samples have been collected at RFETS.

The sitewide receptors are only exposed to surface soil. The sampling locations for surface soil at RFETS are shown on Figure 1.3, and the analytical program is summarized in Table 1.1. The data summary for detected analytes in surface soil is provided in Table 1.2. Ecological Contaminants of Interest (ECOIs) that were analyzed for but not detected are presented in Attachment 1. Detection limits are compared to ecological screening levels (ESLs) and discussed in Attachment 1 (Table A1.1). A detailed description of data storage and processing methods is provided in Appendix A, Volume 2 of the RI/FS Report. The complete data set for surface soil at RFETS is provided on a compact disc (CD) in Attachment 6. In accordance with the CRA Methodology, only data collected on or after June 28, 1991, are used in the CRA.

Data meeting the CRA requirements are available for up to 2,709 surface soil samples collected at RFETS that were analyzed for inorganics (2,709 samples), organics (1,932 samples), and radionuclides (2,462 samples) (Table 1.1). Representatives from all three of these analyte groups were detected (Table 1.2). Dioxin congener concentrations have been converted to 2,3,7,8-TCDD toxicity equivalents (TEQ) by applying toxicity equivalency factors (TEFs) using the procedure described in Appendix A, Volume 2 of the RI/FS report. Results are provided in Table 1.3.

1.2 Data Adequacy Assessment

A data adequacy assessment was performed to determine whether the available data set discussed in the previous section is adequate for risk assessment purposes. The data adequacy assessment rules are presented in the CRA Methodology, and a detailed data adequacy assessment for the data used in the CRA is presented in Appendix A, Volume 2 of the RI/FS Report. The adequacy of the data was assessed by examining the number of available samples for each analyte group in each medium for use in the CRA, the spatial and temporal representativeness of the data, as well as information on potential historical sources of contamination, migration pathways, and the concentration levels in the media. The assessment concludes that the data are adequate for the purposes of the CRA.

1.3 Data Quality Assessment

A Data Quality Assessment (DQA) for the surface soil data was conducted to determine whether the data were of sufficient quality for risk assessment use. The DQA is presented in Appendix A, Volume 2 of the RI/FS Report. It was concluded that the data are of sufficient quality for use in this CRA.

2.0 IDENTIFICATION OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN

The ECOPC identification process for the ERA streamlines the ecological risk characterization by focusing the assessment on ecological contaminants of interest

(ECOIs) that are present throughout the RFETS. ECOIs are defined as any chemical detected in the surface soils in the RFETS.

The ECOPC identification process is based on the site conceptual model (SCM) presented in the CRA Methodology and described in detail in Appendix A, Volume 2 of the RI/FS Report. The SCM presents the pathways of potential exposure from documented historical potential source areas (IHSSs) to the receptors of concern. The most significant exposure pathways for the sitewide ecological receptors are the ingestion of plant, invertebrate, or animal tissue that could have accumulated ECOIs from the source areas through direct uptake or dietary routes, as well as the direct ingestion of potentially contaminated media.

Wide-ranging receptors of concern that were selected for assessment are identified in Table 2.1. They are large home-range receptors, and include coyotes (carnivore, insectivore and generalist) and mule deer. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within RFETS, their potential to come into contact with ECOIs, and the amount of life history and behavioral information available.

The ECOPC identification process for all receptors and the assumptions inherent in this procedure are provided in Appendix A, Volume 2 of the RI/FS Report. No observed adverse effect level (NOAEL) ecological screening levels (ESLs) and threshold ESLs (tESLs) for each ECOI are also identified in the CRA Methodology.

2.1 Data Used in the Ecological Risk Assessment

Data meeting the CRA requirements are available for up to 2,709 surface soil samples collected at RFETS (Table 1.1). A data summary is provided in Table 1.2. Sediment and surface water data for the aquatic ERA also were collected. These data are evaluated in Appendix A, Volume 15B of the RI/FS Report.

2.2 Identification of Surface Soil Ecological Contaminants of Potential Concern

ECOPCs for surface soil were identified for the wide-ranging receptors in accordance with the sequence presented in the CRA Methodology.

2.2.1 Comparison with No Observed Adverse Effect Level Ecological Screening Levels

In the first step of the ECOPC identification process, the maximum detected concentrations (MDCs) of ECOIs in surface soil were compared to receptor-specific NOAEL ESLs. NOAEL ESLs for surface soil were developed in the CRA Methodology for terrestrial vertebrates (which includes wide-ranging receptors).

The NOAEL ESLs for the sitewide receptors are compared to MDCs in surface soil in Table 2.1. The results of the NOAEL ESL screening analyses for all receptor types are summarized in Table 2.2. Analytes with a "Yes" in the "Exceedance" column in Table 2.2 are evaluated further.

NOAEL ESLs were not available for several ECOI/receptor pairs (Tables 2.1 and 2.2). These ECOI/receptor pairs are discussed as ECOIs with uncertain toxicity, along with the potential impacts to the risk assessment, in Section 5.0.

2.2.2 Surface Soil Frequency of Detection Evaluation

The ECOPC identification process for non-PMJM receptors involves an evaluation of detection frequency for each ECOI retained after the NOAEL screening step. If the detection frequency is less than 5 percent, then population-level risks are considered highly unlikely and the ECOI is not further evaluated.

Three chemicals detected in surface soil that were retained after the NOAEL ESL screening step had a detection frequency less than 5 percent (2,4,6-trichlorophenol, dieldrin, and pentachlorophenol). These ECOIs have been excluded from further evaluation.

The analyte 2,4,6-trichlorophenol was only detected once out of 1,180 surface soil results. The sampling locations and detections are presented on Figure 2.1. The detected sample was located in the IAEU and was not shown to be a potential risk in the IAEU CRA due to a low frequency of detection. This ECOI was not carried forward in the ECOPC identification process for wide-ranging receptors either. Population-level risk from one detection throughout the entire RFETS is highly unlikely.

Dieldrin was detected in 11 of 468 surface soil results in the RFETS. Figure 2.2 shows the sampling locations and detections. Most of the detections (eight) were located in three separate groupings within the IAEU. The remaining detections were scattered throughout the RFETS with no other detections nearby. Dieldrin was, therefore, eliminated from further consideration in the ECOPC identification process based on the low percentage of detection and the isolation of detections. It is unlikely that population-level risks would be predicted based on the isolated detections of dieldrin.

Pentachlorophenol was detected in 12 of 1,180 surface soil results. Figure 2.3 shows the sampling locations and detections. Most of these detections (11) were in the IAEU, three of which were located within IHSS 700-7. However, the total area of the IHSS is less than 0.10 acre. All other detections were isolated with no other detections nearby. Pentachlorophenol is, therefore, eliminated from further consideration in the ECOPC identification process based on the low percentage of detections and the very small total area where detections were found. It is highly unlikely that population-level risks would be predicted in the based on the small number of detections of pentachlorophenol.

2.2.3 Surface Soil Background Comparisons

The ECOIs retained after the NOAEL ESL screening and the detection frequency evaluation were then compared to site-specific background concentrations where available. The background comparison is discussed in Attachment 3. The statistical methods used for the background comparison are summarized in Appendix A, Volume 2 of the RI/FS Report.

The results of the background comparisons for the wide-ranging receptors are presented in Table 2.3. The analytes listed as being retained as ECOIs in Table 2.3 are evaluated further using upper-bound EPCs in the following section.

2.2.4 Exposure Point Concentration Comparisons to Threshold ESLs

The ECOIs retained after completion of all previous evaluations are then compared to tESLs using EPCs specific to large home-range receptors. The calculation of EPCs is described in Appendix A, Volume 2 of the RI/FS Report.

Statistical concentrations for each ECOI retained for the tESL screen are presented in Table 2.4. The EPC for large home-range receptors is the upper confidence limit (UCL) on the mean, or the MDC in the event that the UCL is greater than the MDC. The EPC for each ECOI is compared to the limiting large home-range receptor tESL (if available).

The EPCs are compared to the tESLs in Table 2.5. ECOIs with EPCs that exceed the tESLs are assessed in the professional judgment evaluation. Any ECOI/receptor pairs that are retained through professional judgment are identified as ECOPCs and are carried forward in the risk characterization.

2.2.5 Surface Soil Professional Judgment Evaluation

Based on the weight-of-evidence professional judgment described in Attachment 3, nickel and 2,3,7,8-TCDD (TEQ) (mammal) in sitewide surface soils were identified as ECOPCs and retained for further evaluation in the risk characterization.

2.2.6 Summary of Surface Soil Ecological Contaminants of Potential Concern

Inorganic, organic, and radionuclide surface soil ECOIs for wide-ranging receptors were eliminated from further consideration as ECOPCs based on one of the following: 1) the MDC of the ECOI was less than the lowest ESL; 2) no ESLs were available (these ECOIs are discussed in Section 5.3); 3) the concentration of the ECOI in RFETS surface soils was not statistically greater than background surface soils; 4) the upper-bound EPC did not exceed the limiting tESL; or 5) the weight-of-evidence, professional judgment evaluation indicated that the ECOI was not a site-related contaminant of potential concern. Chemicals that were retained are identified as ECOPCs.

A summary of the ECOPC screening process for wide-ranging receptors is presented in Table 2.6. Receptors of potential concern for each ECOPC are also presented. The ECOPC/receptor pairs are evaluated further in Section 3.0 (Ecological Exposure Assessment), Section 4.0 (Ecological Toxicity Assessment), and Section 5.0 (Ecological Risk Characterization).

3.0 ECOLOGICAL EXPOSURE ASSESSMENT

The ECOPC identification process defined the steps necessary to identify those chemicals that could not reliably be removed from further consideration in the ERA process. The

list of ECOPC/receptor pairs of potential concern (Table 3.1) represents those media, chemicals, and receptors that require further assessment. The characterization of risk defines a range of potential exposures to site receptors from the ECOPCs and a parallel evaluation of the potential toxicity of each of the ECOPCs as well as the uncertainties associated with the risk characterization. This section provides the estimation of potential exposure to surface soil ECOPCs for the receptors identified in Section 2.0 and Table 3.1. Details of the dosage-based exposure model, used for the wide-ranging receptors, are presented in Appendix A, Volume 2 of the RI/FS Report.

3.1 Exposure Point Concentrations

Surface soil EPCs for wide-ranging receptors were calculated using both Tier 1 and Tier 2 methods as described in the Appendix A, Volume 2 of the RI/FS Report. The 30-acre grid used for the Tier 2 calculations is shown on Figure 3.1. The Tier 1 and Tier 2 UTLs and UCLs are presented in Table 3.2.

Surface water EPCs are based on the same statistics used for the soil EPCs (i.e., the UCL) and are used to estimate the total exposure via the surface water ingestion pathway. Surface water (total concentration) EPCs for all ECOPCs are presented in Table 3.3. All surface water data are provided on CD in Attachment 6.

3.2 Receptor-Specific Exposure Parameters

Receptor-specific exposure factors are needed to estimate exposure to ECOPCs for each representative species. These include body weight; food, water, and media ingestion rates; and diet composition and respective proportion of each dietary component. Daily rates for intake of forage, prey, water, and incidental ingestion of soils were developed in the CRA Methodology and are presented in Table 3.4 for the receptors of potential concern carried forward in the Sitewide ERA.

3.3 Bioaccumulation Factors

The measurement or estimation of concentrations of ECOPCs in wildlife food is necessary to evaluate how much of a receptor's exposure is via food versus direct uptake of contaminated media. Conservative bioaccumulation factors (BAFs) were identified in the CRA Methodology. These BAFs are either simple ratios between chemical concentrations in biota and soil or are based on quantitative relationships such as linear, logarithmic, or exponential equations. The values reported in the CRA Methodology are used as the BAFs for purposes of risk estimation.

3.4 Intake and Exposure Estimates

Intake and exposure estimates were completed for each ECOPC/receptor pair identified in Table 3.1. The estimates use the default exposure parameters and BAFs presented in Appendix B of the CRA Methodology and described in the previous subsection. These intake calculations represent conservative estimates of food tissue concentrations calculated from the range of upper-bound EPCs including the Tier 1 and Tier 2 UCLs.

The intake and exposure estimates for ECOPC/receptor pairs are presented in Attachment 4. A summary of the exposure estimates for the following is presented in Table 3.5:

- Nickel – Coyote (generalist and insectivore).
- 2,3,7,8-TCDD (TEQ) (mammal) – Coyote (insectivore)

4.0 ECOLOGICAL TOXICITY ASSESSMENT

Exposure to wildlife receptors was estimated for representative species of functional groups based on taxonomy and feeding behavior in Section 3.0 in the form of a daily rate of intake for each ECOPC/receptor pair. To estimate risk, calculated intakes must then be compared to the toxicological properties of each ECOPC. The laboratory-based toxicity benchmarks are termed toxicity reference values (TRVs) and are of several basic types. The NOAEL and no observed effect concentration (NOEC) TRVs are intake rates or soil concentrations below which no ecologically significant effects are expected. The NOAEL and NOEC TRVs were used to calculate the NOAEL ESLs employed in screening steps of the ECOPC identification process to eliminate chemicals that have no potential to cause risk to the representative receptors. The lowest observed adverse effects level (LOAEL) TRV is a concentration above which the potential for some ecologically significant adverse effect could be elevated. The threshold TRVs represent the hypothetical dose at which the response for a group of exposed organisms may first begin to be significantly greater than the response for unexposed receptors and is calculated as the geometric mean of the NOAEL and LOAEL. Threshold TRVs were calculated based on specific data quality rules for use in the ECOPC identification process for a small subset of ECOIs in the CRA Methodology.

TRVs for ECOPCs identified for this ERA were obtained from the CRA Methodology. The pertinent TRVs for wide-ranging mammals are presented in Table 4.1.

5.0 ECOLOGICAL RISK CHARACTERIZATION

Risk characterization includes risk estimation and risk description. Details of these components are described in the CRA Methodology and Appendix A, Volume 2 of the RI/FS Report. Predicted risks should be viewed in terms of the potential for the assumptions used in the risk characterization to occur in nature, the uncertainties associated with the assumptions, and in the potential for effects on the population of receptors that could inhabit the RFETS.

As described in Section 1.1, numerous historical IHSSs, PACs, or UBC sites are located within the boundaries of the RFETS. All of these historical sites were considered in the risk characterization process.

Potential risks to wide-ranging receptors (coyote and mule deer) are evaluated using a hazard quotient (HQ) approach. An HQ is the ratio of the estimated exposure of a

receptor to a TRV that is associated with a known level of toxicity, either a NOAEL or a lowest observed adverse effect level (LOAEL):

$$HQ = Exposure / TRV$$

As described in Section 3.0, TRVs for mammals are expressed as ingested doses (mg/kg/BW/day). In general, if the NOAEL-based HQ is less than 1, then no adverse effects are predicted. If the LOAEL-based HQ is less than 1 but the NOAEL-based HQ is above 1, then some adverse effects are possible, but it is expected that the magnitude and frequency of the effects will usually be low (assuming the magnitude and severity of the response at the LOAEL are not large and the endpoint of the LOAEL accurately reflects the assessment endpoints for that receptor). If the LOAEL-based HQ is greater than or equal to 1, the risk of an adverse effect is of potential concern, with the probability and/or severity of effect tending to increase as the value of the HQ increases.

When interpreting HQ results for wide-ranging ecological receptors, it is important to remember that the assessment endpoint is based on the sustainability of exposed populations, and risks to some individuals in a population may be acceptable if the population is expected to remain healthy and stable.

HQs were calculated for each ECOPC/receptor pair based on the exposures estimated and TRVs presented in the preceding sections. Risks are discussed and presented to put the assumptions of the risk predictions into context that can be used to make risk management decisions.

5.1 Chemical Risk Characterization

As noted above, the quantitative method used to characterize chemical risk is the HQ approach. HQs are usually interpreted as follows:

HQ Values		Interpretation of HQ Results
NOAEL-based	LOAEL-based	
≤ 1	≤ 1	Minimal or no risk
> 1	≤ 1	Low level risk[a]
> 1	> 1	Potentially significant risk

[a] Assuming magnitude and severity of response at LOAEL are relatively small and based on endpoints appropriate for the assessment endpoint of the receptor considered.

One potential limitation of the HQ approach is that calculated HQ values may sometimes be uncertain due to simplifications and assumptions in the underlying exposure and

toxicity data used to derive the HQs. Where possible, this risk assessment provides information on three potential sources of uncertainty, described below.

- **Exposure Point Concentrations (EPCs).** Because surface soil sampling programs in the EU sometimes tended to focus on areas of potential contamination (IHSS/PAC/UBCs), EPCs calculated using the Tier 1 approach (which assumes that all samples are randomly spread across the EU and are weighted equally) may tend to yield an EPC that is biased high. For this reason, a Tier 2 area-weighting approach was used to derive additional EPCs that help compensate for this potential bias. HQs were always calculated based on both Tier 1 and Tier 2 EPCs for sitewide receptors.

- **Bioaccumulation Factors (BAFs).** For wildlife receptors, concentrations of contaminants in dietary items were estimated from surface soil using uptake equations. When the uptake equation was based on a simple linear model (e.g., $C_{tissue} = BAF * C_{soil}$), the default exposure scenario used a high-end estimate of the BAF (the 90th percentile BAF). However, the use of high-end BAFs may tend to overestimate tissue concentrations in some dietary items. In order to estimate more typical tissue concentrations, where necessary, an alternate exposure scenario calculated total chemical intake using a 50th percentile (median) BAF and HQs were calculated. The use of the median BAF is consistent with the approach used in the ecological soil screening level (EcoSSL) guidance (EPA 2005).

- **Toxicity Reference Values (TRVs).** The CRA Methodology utilized an established hierarchy to identify the most appropriate default TRVs for use in the ECOPC selection. However, in some instances, the default TRV selected may be overly conservative with regard to characterizing population-level risks. The determination of whether the default TRVs are thought to yield overly conservative estimates of risk is addressed in the uncertainty sections below on a chemical-by-chemical basis. When an alternate TRV is identified, the chemical-specific uncertainty sections provide a discussion of why the alternate TRV is thought to be appropriate to provide an alternative estimate of toxicity (e.g., endpoint relevance, species relevance, data quality, chemical form, etc.), and HQs were calculated using both default and alternate TRVs where necessary.

The influences of each of these uncertainties on the calculated HQs were evaluated both alone and in concert in the risk description for each chemical. Uncertainties related to the BAFs, TRVs and background risk are presented for each chemical in Attachment 5. Where uncertainties were deemed to be high, Attachment 5 provided alternative BAFs and/or TRVs as appropriate based on the results of the uncertainty assessment.

HQs calculated using the default BAFs and with the Tier 1 and Tier 2 EPCs are provided in Table 5.1 for each ECOPC/receptor pair. Where no LOAEL HQs exceed 1 using the default exposure and toxicity values, no further HQs were calculated regardless of the results of the uncertainty analysis. Since the default HQs are generally the most

conservative risk estimations, if low risk is estimated using these values then further reductions of conservatism would only serve to reduce risk estimates further.

If LOAEL HQs greater than 1 are calculated using default assumptions, and the uncertainty analysis indicated that alternative BAFs and/or TRVs would be beneficial to reduce uncertainty and conservatism, alternative HQs are presented in Table 5.1 as appropriate.

The selection of which EPC (e.g., UTL or UCL) is of primary importance will depend upon the type of receptor and the relative home range size. Only the UCL EPC is provided in Table 5.1 for the wide-ranging receptors.

All calculated exposure estimates and HQ values are also provided in Attachment 4. These include the HQs calculated using a range of EPCs. The results for each ECOPC are discussed in more detail below.

The risk description incorporates results of the risk estimates along with the uncertainties associated with the risk estimations and other lines of evidence to evaluate potential chemical effects on ecological receptors in the RFETS following accelerated actions. Information considered in the risk description includes receptor groups potentially affected, type of TRV exceeded (e.g., NOAEL versus LOAEL), relation of sitewide concentrations to other criteria such as EPA EcoSSLs, and risk above background conditions. In addition, other site-specific and regional factors are considered such as the use of a given ECOPC within the RFETS as related to historical RFETS activities, comparison of ECOPC concentrations within the RFETS as it relates to background, and/or comparison to regional background concentrations.

5.1.1 Nickel

Nickel HQs for the coyote (generalist and insectivore) are presented in Table 5.1. Figure 5.1 shows the spatial distribution of nickel in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

HQs Calculated to Characterize Uncertainty

Uncertainties related to the default HQ calculations provided in Table 5.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs and background risks are presented.

Neither coyote receptor (generalist and insectivore) had LOAEL HQs greater than 1, indicating that risks based on the default assumptions were low, and no alternative HQs were calculated.

Care should be taken to review the chemical specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

Nickel – Risk Description

Nickel was identified as an ECOPC for the coyote (generalist and insectivore). Information on the historical use of nickel and a summary of site data and background data is provided in Attachment 3.

Wide-Ranging (Large Home-Range) Receptors

NOAEL HQs were greater than 1 for the coyote (generalist and insectivore) under the default exposure/TRV scenarios (Table 5.1). LOAEL HQs for both receptors were less than or equal to 1 for all exposure scenarios.

Table 5.2 presents a summary of HQs calculated using the arithmetic mean concentrations used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Nickel samples were available from 201 grid cells (Figure 5.1). NOAEL HQs greater than 10 were only calculated in 7 percent of the grid cells. NOAEL HQs between 5 and 10 were calculated in 77 percent of the grid cells, and NOAEL HQs between 1 and 5 were calculated in 16 percent of the grid cells. LOAEL HQs less than 1 were calculated in 93 percent of grid cells, with the remaining 7 percent of HQs ranging from 1 to 5. The results of the grid-cell analysis indicate that risks from average exposure to sub-populations of wide-ranging receptors are low.

The uncertainty analysis discussed uncertainties and conservatisms related to both upper-bound BAFs used in the intake estimates and in the TRVs used to calculate HQs. However, since risks are classified as low using the more conservative default HQ calculations, no alternative HQs were calculated. Risks are likely to be low to populations of all large home range receptors from exposure to nickel in the RFETS.

5.1.2 2,3,7,8-TCDD (TEQ) (Mammal)

HQs for 2,3,7,8-TCDD (TEQ) (mammal) for the coyote (insectivore) are presented in Table 5.1. Figure 5.2 shows the spatial distribution of 2,3,7,8-TCDD (TEQ) (mammal) in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. It should be noted that the 2,3,7,8-TCDD (TEQ) (mammal) concentrations located southwest of the former Industrial Area are at a depth of approximately 20 feet bgs. In this area, confirmation samples were collected at the bottom of an excavation after completion of an accelerated action soil removal. These samples were classified as surface soil and were included in the risk assessment even though the excavation was backfilled and the samples are technically from the subsurface. The coyote (insectivore) would not be exposed to dioxins in this area.

HQs Calculated to Characterize Uncertainty

Uncertainties related to the default HQ calculations provided in Table 5.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs and background risks are presented.

No LOAEL HQs greater than 1 were calculated for the coyote (insectivore) receptor. Therefore, no alternative HQ calculations are provided.

Care should, however, be taken to review the chemical specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

2,3,7,8-TCDD (TEQ) (Mammal) – Risk Description

2,3,7,8-TCDD (TEQ) (mammal) was identified as an ECOPC for the coyote (insectivore) receptor.

Wide-Ranging (Large Home-Range) Receptors

Potential risks from exposure to 2,3,7,8-TCDD (TEQ) (mammal) were evaluated using a range of EPCs. NOAEL HQs were less than 1 for both the Tier 1 and Tier 2 UCLs (Table 5.1). All LOAEL HQs were less than 1 for both receptors. Given the lack of LOAEL HQs greater than 1, risks to wide-ranging receptors from 2,3,7,8-TCDD (TEQ) (mammal) in surface soils in the RFETS are likely low.

Table 5.2 presents a summary of HQs calculated using the arithmetic mean concentrations used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. 2,3,7,8-TCDD (TEQ) (mammal) samples were available from 4 grid cells (Figure 5.2). NOAEL HQs were less than 1 (using the UCL) for 100 percent of the grid cells. In addition, none of the grids had LOAEL HQs greater than 1 for the coyote (insectivore). The results of the grid-cell analysis indicate that the average exposure to sub-populations of wide-ranging receptors indicate low risk from exposure to dioxin (total).

5.2 Ecosystem Characterization

An ecological monitoring program has been underway since 1991 when baseline data on wildlife species was gathered (Ebasco 1992). The purpose of this long-term program was to monitor specific habitats to provide a sitewide database from which to monitor trends in the wildlife populations at RFETS. This type of monitoring program provides localized information that can also be used for analysis at a landscape level, to monitor the population trends and general health of the Rocky Flats ecosystem. Permanent transects through three basic habitats were run monthly for over a decade (K-H 2002). Observations concerning the abundance, distribution and diversity of wide-ranging wildlife species were recorded including observations of deer and coyotes.

Big game species and carnivores were observed through relative abundance surveys and multi-species surveys (16 permanent transects) that provided species specific sitewide counts. Elk (*Cervus canadensis*) and two deer species, mule deer (*Odocoileus hemionus*) and white-tail deer (*Odocoileus virginianus*), inhabit RFETS. No white-tail deer were present at RFETS in 1991 when monitoring began (K-H 2002). In 2000 (K-H 2001), the population of white-tail deer was estimated between 10 and 15 individuals. White-tailed

deer spend the majority of their time in Lower Woman Creek. Mule deer frequent all parts of RFETS (14 mi^2) year-round. The RFETS mule deer population from winter counts is estimated at a mean 125 individuals (n = 7) with a density of 14 deer per square mile (K-H 2000, 2002). Winter mule deer counts have varied from 100 to 160 individuals over the monitoring period (1994 to 2000) with expected age/sex class distributions (K-H 2001). The population at RFETS is "open" with individuals able to move freely on- an off-site. In comparison, mule deer populations at the Rocky Mountain Arsenal (27 mi^2) are estimated between 175 to 213 individuals based on ground observations (Whittaker 1993). This equates to a density of 93.6 km^2 (36.1mi^2), a much denser population. The number of mule deer at the Rocky Mountain Arsenal increased substantially toward the end of the study. The U.S. Army had erected a chain-link fence around the site in the early 1990s (Skipper 2005) and effectively closed the population negating any immigration. Prior to the fence being installed, mule deer densities were estimated at 44.3 km^2 (17 mi^2) similar to what has been observed at RFETS. The mule deer population within RFETS has continued to increase at a steady state with good age/sex distributions (K-H 2001) over time and similar densities compared to other "open" populations that are not hunted. This provides a good indicator that habitat quality is high and that site activities have not affected deer populations. It is unlikely that deer populations are depressed or reproduction is affected by contaminants. A recent study on actinides in deer tissue found that plutonium levels were near or below detection limits (Todd and Sattelberg 2004). This provides further support that the deer population is healthy.

The western area of RFETS acts as a travel corridor for large mammals connecting Coal Creek and the foothills to the west of RFETS. Despite mining activities in this area, elk and mule deer travel thought this corridor to calve and fawn in upper Rock Creek in late spring. Elk use at RFETS appears to be increasing (Nelson 2005) and gives an indication of the desirable habitat quality found at the site. Black bear (*Ursus americanus*) also use this corridor to access RFETS. Several individuals have been observed over the past few years (K-H 2001).

Coyotes (*Canis latrans*) are the top mammalian predator at RFETS. They prey upon mule deer fawns and other smaller prey species. The number of coyotes using the site has been estimated at 14 to 16 individuals (K-H 2002). Through surveys across the site, coyotes have been observed having reproduction success with as many as 6 dens active in one year (Nelson 2004). Typically at RFETS, three to six coyote dens support an estimated 14 to 16 individuals at any given time (K-H 2001). Coyotes have exhibited a steady population over time which indicates their prey species continue to be abundant and healthy.

The high species diversity and continued use of the site by numerous vertebrate species verifies that habitat quality for these species remains acceptable and the ecosystem functions are being maintained (K-H 2000). Data collected on wildlife abundance and diversity indicate that wildlife populations are stable and species richness remains high during remediation activities at RFETS.

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5.3 General Uncertainty Analysis

Quantitative evaluation of ecological risks is limited by uncertainties regarding the assumptions used to predict risk and the data available for quantifying risk. These limitations are usually addressed by making estimates based on the data available or by making assumptions based on professional judgment when data are limited. Because of these assumptions and estimates, the results of the risk calculations themselves are uncertain, and it is important for risk managers and the public to view the results of the risk assessment with this in mind. Chemical-specific uncertainties are presented in Attachment 5 of this document and were discussed in terms of their potential effects on the risk characterization in the risk description section for each ECOPC. A full discussion of categories of general uncertainty that are not specific to the sitewide ERA is presented in Appendix A, Volume 2 of the RI/FS Report. The following sections are potential sources of general uncertainty that are specific to the sitewide ERA.

5.3.1 Uncertainties Associated With Data Adequacy and Quality

Sections 1.2 and 1.3 summarize the general data adequacy and data quality for the sitewide ERA, respectively. A more detailed discussion is presented in Attachment 2 and Appendix A, Volume 2 of the RI/FS Report. The data adequacy assessment indicates that the data are adequate for the CRA. Data of sufficient quality for ERA purposes were collected for surface soil.

5.3.2 Uncertainties Associated with the Lack of Toxicity Data for Ecological Contaminants of Interest Detected in RFETS Surface Soil

Several ECOIs detected in the RFETS do not have adequate toxicity data for the derivation of ESLs (CRA Methodology). These ECOIs are listed in Tables 2.1and 2.9 with a "UT" designation. Appendix B of the CRA Methodology outlines a detailed search process that was intended to provide high quality toxicological information for a large proportion of the chemicals detected at RFETS. Although the toxicity is uncertain for those ECOIs that do not have ESLs calculated due to a lack of identified toxicity data, the overall effect on the risk assessment is small because the primary chemicals historically used at RFETS have adequate toxicity data for use in the CRA. Therefore, while the potential for risk from these ECOPCs is uncertain and will tend to underestimate the overall risk calculated, the magnitude of underestimation is likely to be low.

5.3.3 Uncertainties Associated With Eliminating Ecological Contaminants of Interest Based on Professional Judgment

No analytes in surface soil were eliminated as ECOIs based on professional judgment.

5.3.4 Uncertainties Associated with the Risk Characterization

As previously mentioned, some of the surface soil 2,3,7,8-TCDD (TEQ) (mammal) data are technically subsurface data because they were collected as confirmation samples from the bottom of an excavation following an accelerated action soil removal, and the

excavation has been backfilled. The coyote (insectivore) would not be exposed to dioxins in this area.

5.3.5 Summary of Significant Sources of Uncertainty

The preceding discussion outlined the significant sources of uncertainty in the CRA process for assessing ecological risk. While some of the sources of uncertainty discussed tend to underestimate risk, an equal or greater number of uncertainties discussed for each ECOPC and in RI/FS Appendix A indicate that risk estimations may be somewhat biased toward the overestimation of risk to a generally unknown degree.

6.0 REFERENCES

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TABLES

Table 1.1
Number of Samples Collected in Surface Soil by Analyte Suite

Analyte Group Type	SurfaceSoil
Inorganic	2,709
Organic	1,932
Radionuclide	2,462

Table 1.2
Summary of Detected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits		Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration*	Standard Deviation*
Inorganics (mg/kg)								
Ammonia	0.300 -	0.300	32	78.1	0.335	4.81	1.87	1.27
Antimony	3.60E-04 -	60	2,482	20.0	0.270	348	2.25	7.95
Arsenic	2.20E-04 -	10	2,613	99.0	0.290	56.2	4.78	2.98
Barium	7.10E-04 -	200	2,624	99.9	0.640	1,500	99.6	67.3
Beryllium	2.90E-05 -	5	2,623	81.7	0.0710	26.8	0.639	0.683
Boron	0.00360 -	1.70	1,303	85.7	0.350	28	3.84	2.77
Cadmium	2.50E-05 -	5	2,603	36.1	0.0600	270	0.689	5.66
Calcium	0.0310 -	5,000	2,622	100.0	270	210,000	9,023	15,873
Cesium	9.10 -	1,000	1,029	26.3	0.690	18.8	11.8	19.6
Chromium	1.00E-04 -	10	2,624	99.2	1.20	210	15.4	13.2
Chromium VI	0.530 -	10	17	5.88	0.850	0.850	0.424	0.167
Cobalt	2.90E-04 -	50	2,622	98.1	1.10	137	6.63	5.19
Copper	3.60E-04 -	25	2,621	98.2	1.70	1,860	21.9	54.5
Cyanide	0.140 -	2.50	245	2.45	0.170	0.290	0.496	0.475
Fluoride	1 -	1	9	100	1.87	3.61	2.42	0.497
Iron	0.0120 -	100	2,622	100.0	2,610	130,000	13,671	5,896
Lead	2.90E-05 -	17.2	2,618	100	0.870	814	25.1	39.2
Lithium	9.50E-04 -	100	2,433	94.5	0.990	50	8.89	4.28
Magnesium	0.0160 -	5,000	2,633	100.0	180	30,000	2,656	1,652
Manganese	2.20E-04 -	15	2,617	99.9	15	2,220	227	139
Mercury	0 -	0.300	2,541	48.8	0.00140	48	0.0670	0.956
Molybdenum	9.90E-04 -	200	2,421	47.0	0.140	19.1	0.984	1.06
Nickel	3.40E-04 -	40	2,620	97.5	1.90	280	12.3	10.7
Nitrate / Nitrite	0.0500 -	31.7	450	83.3	0.216	765	13.4	59.8
Nitrite	0.240 -	0.260	11	90.9	1.20	2	1.69	0.405
Potassium	0.0290 -	5,000	2,621	99.5	270	8,310	2,002	866
Selenium	5.40E-04 -	5	2,590	13.3	0.220	2.20	0.368	0.213
Silica	0.00630 -	7	1,259	100	59.3	1,880	664	227
Silicon	0 -	100	187	98.9	75.1	11,300	1,508	1,780
Silver	9.40E-06 -	10	2,589	28.4	0.0580	364	1.01	8.25
Sodium	0.0330 -	5,000	2,622	56.1	22.6	6,600	237	433
Strontium	7.20E-04 -	200	2,423	100.0	2.40	413	32.5	29.9
Thallium	1.60E-04 -	10	2,597	14.1	0.100	5.80	0.421	0.415
Tin	7.80E-04 -	200	2,423	10.0	0.289	161	3.44	8.13
Titanium	2.20E-04 -	0.250	1,303	100	28	1,730	257	170
Total Petroleum Hydrocarbons	0.250 -	77.6	21	95.2	0.500	2,400	316	557
Uranium	6.30E-04 -	16.8	1,296	8.80	0.430	370	1.80	12.7
Vanadium	6.30E-04 -	50	2,622	100.0	4.40	5,300	36.5	143
Zinc	5.60E-04 -	20	2,622	99.8	4.20	11,900	75.5	257
Organics (ug/kg)								
1,1,1-Trichloroethane	0.120 -	590	633	1.58	1.10	47.7	2.26	14.0
1,1,2-Trichloro-1,2,2-trifluoroethane	0.120 -	590	517	0.193	1.83	1.83	1.24	3.23
1,1-Dichloroethene	0.310 -	590	633	0.158	7.90	7.90	2.26	13.8
1,2,3-Trichlorobenzene	0.220 -	590	515	0.777	0.960	1.70	1.03	2.97
1,2,3-Trichloropropane	0.300 -	590	517	0.193	1.47	1.47	1.01	3.29
1,2,4-Trichlorobenzene	0.170 -	2,100	1,549	0.323	0.870	150	163	199
1,2,4-Trimethylbenzene	0.120 -	590	515	8.93	0.680	1,300	5.38	66.2
1,2-Dichloroethene	5 -	28	101	0.990	16	16	7.95	33.5
1,2-Dichloropropane	0.100 -	590	633	0.316	18	140	2.27	14.8
1,3,5-Trimethylbenzene	0.130 -	590	515	6.60	0.610	490	2.69	25.6
1,4-Dichlorobenzene	0.150 -	78,000	1,329	0.677	0.450	110	125	147
1234678-HpCDF	0 -	0.00269	22	95.5	2.35E-04	0.240	0.0195	0.0504
1234789-HpCDF	0 -	0.00269	22	59.1	3.40E-04	0.0250	0.00204	0.00521
123478-HxCDD	0 -	0.00269	22	63.6	2.20E-04	0.00730	8.88E-04	0.00151
123478-HxCDF	0 -	0.00269	22	81.8	4.50E-04	0.140	0.0106	0.0296
123678-HxCDD	0 -	0.00269	22	86.4	3.90E-04	0.0120	0.00190	0.00255
123678-HxCDF	0 -	0.00269	22	86.4	1.70E-04	0.0430	0.00375	0.00908
123789-HxCDD	0 -	0.00269	22	81.8	2.20E-04	0.0210	0.00204	0.00433
123789-HxCDF	0 -	0.00269	22	31.8	1.60E-04	0.00250	3.64E-04	5.98E-04
12378-PeCDF	0 -	0.00269	22	63.6	2.90E-04	0.0280	0.00292	0.00613
2,4,5-T	1 -	100	9	11.1	1.80	1.80	18.5	18.1
2,4,5-Trichlorophenol	27 -	5,200	1,180	0.0847	1,100	1,100	593	659
2,4,6-Trichlorophenol	39 -	2,100	1,180	0.085	950	950	260	217
2,4,6-Trinitrotoluene	0.220 -	30	8	12.5	56	56	69.5	62.0
2,4-Dimethylphenol	36 -	2,100	1,180	0.254	47	88	259	215
234678-HxCDF	0 -	0.00269	22	77.3	3.10E-04	0.0630	0.00428	0.0132
23478-PeCDF	0 -	0.00269	22	77.3	3.00E-04	0.0560	0.00491	0.0121

Table 1.2
Summary of Detected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits		Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
2378-TCDD	0 -	0.00108	22	68.2	2.59E-05	0.00680	0.00166	0.00217
2378-TCDF	0 -	0.00108	22	81.8	7.60E-04	0.0496	0.00626	0.0117
2-Butanone	1.70 -	12,000	631	2.54	3	155	11.8	37.8
2-Hexanone	0.610 -	5,900	630	0.794	14.7	20	7.57	30.9
2-Methylnaphthalene	31 -	2,100	1,223	6.95	34	12,000	264	396
4,4'-DDD	0.300 -	190	468	0.427	3.50	10	10.1	8.44
4,4'-DDE	0.340 -	190	468	1.50	0.600	7.20	10.2	8.58
4,4'-DDT	0.350 -	190	468	0.855	9.10	26	10.3	8.53
4,6-Dinitro-2-methylphenol	120 -	5,200	1,176	0.0850	390	390	1,258	1,081
4-Chloro-3-methylphenol	33 -	2,100	1,180	0.254	57	67	380	426
4-Isopropyltoluene	0.260 -	590	515	2.91	1	100	1.41	5.76
4-Methyl-2-pentanone	0.780 -	5,900	630	2.38	4	73	10.7	65.6
4-Methylphenol	54 -	2,100	1,180	0.424	64	270	259	215
4-Nitroaniline	60 -	6,600	1,218	0.328	62	820	1,286	1,307
4-Nitrophenol	95 -	5,200	1,169	0.171	53	320	1,258	1,084
Acenaphthene	30 -	2,100	1,239	22.3	21	44,000	273	1,304
Acenaphthylene	27 -	2,100	1,241	0.403	38	600	209	156
Acetone	1.50 -	12,000	632	19.3	1.70	1,280	26.0	92.2
Aldrin	0.410 -	95	468	0.855	0.590	17	5.30	4.28
alpha-BHC	0.390 -	95	468	0.214	7.90	7.90	5.14	3.93
Anthracene	23 -	2,100	1,245	25.3	31	47,000	283	1,370
Benzene	0.100 -	590	633	0.948	1	11	2.00	13.7
Benzo(a)anthracene	24 -	2,100	1,226	49.3	37	45,000	387	1,378
Benzo(a)pyrene	15 -	2,100	1,235	41.2	36	43,000	392	1,293
Benzo(b)fluoranthene	12 -	2,100	1,231	42.5	38	49,000	437	1,518
Benzo(g,h,i)perylene	26 -	2,100	1,214	29.8	15	28,000	317	861
Benzo(k)fluoranthene	31 -	2,100	1,218	35.2	23	25,000	342	801
Benzoic Acid	280 -	5,200	1,135	11.1	39	1,100	1,206	1,137
Benzyl Alcohol	77 -	2,100	1,114	0.718	140	2,800	390	432
beta-BHC	0.360 -	95	467	0.428	11	11	5.16	3.95
beta-Chlordane	1.80 -	950	411	0.243	2.60	2.60	50.6	40.0
bis(2-ethylhexyl)phthalate	69 -	2,100	1,227	29.7	29	75,000	401	2,263
Bromochloromethane	0.100 -	590	517	0.193	7	7	1.05	2.87
Butylbenzylphthalate	34 -	2,100	1,226	9.79	35	7,100	283	327
Carbazole	340 -	400	39	53.8	39	700	207	130
Carbon Disulfide	0.150 -	590	633	0.158	4	4	2.66	14.2
Carbon Tetrachloride	0.180 -	590	633	3.32	0.340	103	2.61	15.4
Chlorobenzene	0.0780 -	590	633	0.316	2	2.03	2.12	13.9
Chloroform	0.0890 -	590	633	1.11	1.30	7	2.02	13.7
Chloromethane	0.350 -	590	633	0.474	1.50	1.70	3.49	28.5
Chrysene	27 -	2,100	1,240	51.3	36	46,000	402	1,403
cis-1,2-Dichloroethene	0.210 -	590	517	1.74	1.10	15	1.85	13.1
delta-BHC	0.120 -	95	468	0.214	23	23	5.18	4.01
Dibenz(a,h)anthracene	20 -	2,100	1,217	13.5	28	9,200	258	338
Dibenzofuran	35 -	2,100	1,227	10.9	36	20,000	274	619
Dicamba	1.90 -	100	9	55.6	2.30	150	39.5	44.8
Dichloroprop	2.30 -	100	9	11.1	10	10	39.9	11.5
Dieldrin	0.390 -	190	468	2.35	1.80	92	10.8	9.98
Diesel Range Organics	960 -	48,000	13	84.6	4,900	8.80E+06	1.80E+06	3.33E+06
Diethylphthalate	30 -	2,100	1,224	0.654	33	420	302	210
Dimethylphthalate	39 -	2,100	1,227	1.47	69	460	261	212
Di-n-butylphthalate	20 -	2,100	1,227	7.99	35	10,000	262	353
Di-n-octylphthalate	36 -	2,100	1,225	3.92	38	11,000	281	496
Endosulfan I	0.400 -	95	468	0.427	3.90	7.40	5.14	3.92
Endosulfan II	0.400 -	170	461	0.651	0.700	9.90	9.78	6.64
Endosulfan sulfate	0.300 -	190	468	0.641	5.50	24	10.1	8.45
Endrin	0.400 -	190	468	1.28	2.40	17	10.8	10.3
Endrin aldehyde	0.510 -	38	66	3.03	8.70	9.20	3.71	3.57
Endrin ketone	0.400 -	190	437	0.229	36	36	10.6	8.59
Ethylbenzene	0.100 -	590	633	7.42	0.709	173	2.91	16.0
Fluoranthene	22 -	2,100	1,235	58.3	37	140,000	763	4,173
Fluorene	33 -	2,100	1,244	18.8	27	39,000	295	1,139
gamma-BHC (Lindane)	0.440 -	95	468	0.214	8.30	8.30	5.13	3.93
Gasoline	100 -	100	30	6.67	720	2,000	344	324
Heptachlor epoxide	0.380 -	95	467	0.642	7.20	23	6.19	6.51
Heptachlorodibenzo-p-dioxin	0 -	0.00269	22	95.5	2.48E-04	0.110	0.0252	0.0288
Hexachlorobenzene	35 -	2,100	1,224	0.327	110	380	261	212
Hexachlorobutadiene	0.320 -	2,100	1,550	0.0645	2.20	2.20	163	199

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Table 1.2
Summary of Detected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits		Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
HMX	60 -	60	5	20	230	230	146	47.0
Indeno(1,2,3-cd)pyrene	22 -	2,100	1,220	33.4	24	32,000	317	962
Isophorone	33 -	2,100	1,227	0.489	96	850	262	213
Isopropylbenzene	0.110 -	590	515	1.94	0.540	27	1.06	2.82
MCPA	210 -	100,000	9	11.1	1,100	1,100	9,000	15,411
Methoxychlor	0.180 -	950	468	1.71	0.280	450	50.1	46.7
Methylene Chloride	0.350 -	590	631	12.0	0.790	45	3.69	43.9
Naphthalene	0.390 -	2,100	1,567	14.1	0.850	41,000	206	1,074
n-Butylbenzene	0.170 -	590	515	1.36	3.70	350	1.94	16.4
N-Nitroso-di-n-propylamine	22 -	2,100	1,222	0.0818	400	400	262	212
n-Propylbenzene	0.250 -	590	515	2.33	1.72	190	1.35	8.67
OCDD	0 -	0.00539	22	95.5	4.15E-04	0.630	0.158	0.154
OCDF	0 -	0.00539	22	100	7.19E-05	0.140	0.0158	0.0288
PCB-1016	1.90 -	4,500	795	0.755	13	95	54.0	138
PCB-1242	2.90 -	4,500	845	0.237	23	350	55.1	136
PCB-1248	3.60 -	4,500	845	0.710	17	840	56.2	138
PCB-1254	4.40 -	9,000	842	17.9	6.80	8,900	199	647
PCB-1260	1.40 -	9,000	838	17.2	6.20	7,800	163	572
Pentachlorodibenzo-p-dioxin	0 -	0.00269	22	68.2	3.20E-04	0.00710	8.51E-04	0.00144
Pentachlorophenol	64 -	5,200	1,180	1.02	39	39,000	1,267	1,473
Phenanthrene	34 -	2,100	1,246	54.7	22	170,000	690	4,952
Phenol	34 -	2,100	1,180	0.424	33	130	260	219
Pyrene	40 -	2,100	1,242	57.2	35	120,000	723	3,603
sec-Butylbenzene	0.160 -	590	515	0.971	2	42.6	1.04	3.11
Styrene	0.0780 -	590	633	0.158	7.80	7.80	2.04	13.7
tert-Butylbenzene	0.210 -	590	515	0.194	1.60	1.60	0.945	2.47
Tetrachloroethene	0.190 -	590	633	8.53	0.380	29,000	49.6	1,153
Toluene	0.0890 -	590	633	9.00	0.0990	990	8.73	62.7
Trichloroethene	0.150 -	590	633	4.11	0.170	200	2.46	15.9
Trichlorofluoromethane	0.230 -	590	517	5.61	0.660	31.9	1.36	3.37
Xylene	0.0330 -	1,200	633	10.4	0.600	933	8.73	50.6
Radionuclides (pCi/g)[b]								
Americium-241	0 -	0.600	2,024	N/A	-0.0820	51.2	0.544	2.06
Cesium-134	0.0166 -	0.300	162	N/A	-0.267	0.150	0.0155	0.0669
Cesium-137	0 -	1	360	N/A	-0.0722	2.50	0.436	0.537
Curium-242	0.0178 -	0.0178	1	N/A	0	0	0	
Curium-244	0.0362 -	0.0362	1	N/A	-0.00290	-0.00290	-0.00290	
Curium-245/246	0.0200 -	0.0200	1	N/A	0.126	0.126	0.126	
Gross Alpha	0.800 -	30	1,202	N/A	-1.20	320	19.2	14.2
Gross Beta	1 -	20	1,275	N/A	-1.30	305	31.9	15.6
Neptunium-237	0.00202 -	0.00634	13	N/A	7.79E-04	0.0187	0.00889	0.00720
Plutonium-238	0.00258 -	0.211	83	N/A	-0.0190	1.53	0.0894	0.241
Plutonium-239/240	0 -	0.373	2,336	N/A	-0.0783	183	2.00	7.12
Radium-226	0 -	1.10	149	N/A	-7.39	2.08	0.924	0.773
Radium-228	0 -	2.90	172	N/A	0.00100	3.50	1.72	0.539
Strontium-89/90	0.0170 -	0.500	289	N/A	-0.160	2.87	0.258	0.282
Uranium-233/234	0 -	2.39	1,901	N/A	0.0817	47.5	1.18	1.59
Uranium-235	0 -	2.55	1,900	N/A	-0.138	2.24	0.0691	0.108
Uranium-238	0 -	1.90	1,901	N/A	0.162	209	1.46	5.56

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[b] All radionuclide values are considered detects.

N/A = Not applicable.

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Table 1.3

Toxicity Equivalency Calculations for Dioxins/Furans - Wide-Ranging Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals	
						TEF[a]	TEQ Concentration[b]
Surface Soil (µg/kg)							
BT38-001	02E0015-005	1234678-HpCDF	0.006	Yes	V	0.010	5.70E-05
BT38-001	02E0015-005	1234789-HpCDF	3.30E-04	No	V	0.010	0
BT38-001	02E0015-005	123478-HxCDD	3.00E-04	No	V	0.100	0
BT38-001	02E0015-005	123478-HxCDF	5.40E-04	Yes	JB	0.100	5.40E-05
BT38-001	02E0015-005	123678-HxCDD	9.70E-04	Yes	V	0.100	9.70E-05
BT38-001	02E0015-005	123678-HxCDF	4.30E-04	Yes	JB	0.100	4.30E-05
BT38-001	02E0015-005	123789-HxCDD	2.80E-04	No	V	0.100	0
BT38-001	02E0015-005	123789-HxCDF	1.60E-04	No	V	0.100	0
BT38-001	02E0015-005	12378-PeCDF	0.001	Yes	V	0.050	6.00E-05
BT38-001	02E0015-005	234678-HxCDF	4.30E-04	Yes	V	0.100	4.30E-05
BT38-001	02E0015-005	23478-PeCDF	6.50E-04	Yes	V	0.500	3.25E-04
BT38-001	02E0015-005	2378-TCDD	0.006	Yes	V	1.00	0.0056
BT38-001	02E0015-005	2378-TCDF	0.004	Yes	V	0.100	3.80E-04
BT38-001	02E0015-005	Heptachlorodibenzo-p-dioxin	0.023	Yes	V	0.010	2.30E-04
BT38-001	02E0015-005	OCDD	0.180	Yes	V	1.00E-04	1.80E-05
BT38-001	02E0015-005	OCDF	0.009	Yes	V	1.00E-04	8.90E-07
BT38-001	02E0015-005	Pentachlorodibenzo-p-dioxin	6.50E-04	Yes	V	1.00	6.50E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 02E0015-005:[c]							**0.008**
BT38-002	02E0015-006	1234678-HpCDF	0.004	Yes	V	0.010	3.50E-05
BT38-002	02E0015-006	1234789-HpCDF	5.10E-04	No	V	0.010	0
BT38-002	02E0015-006	123478-HxCDD	3.80E-04	No	V	0.100	0
BT38-002	02E0015-006	123478-HxCDF	5.30E-04	Yes	JB	0.100	5.30E-05
BT38-002	02E0015-006	123678-HxCDD	8.40E-04	Yes	V	0.100	8.40E-05
BT38-002	02E0015-006	123678-HxCDF	5.30E-04	Yes	V	0.100	5.30E-05
BT38-002	02E0015-006	123789-HxCDD	6.30E-04	Yes	V	0.100	6.30E-05
BT38-002	02E0015-006	123789-HxCDF	2.60E-04	No	V	0.100	0
BT38-002	02E0015-006	12378-PeCDF	3.00E-04	No	V	0.050	0
BT38-002	02E0015-006	234678-HxCDF	2.30E-04	No	V	0.100	0
BT38-002	02E0015-006	23478-PeCDF	4.20E-04	Yes	V	0.500	2.10E-04
BT38-002	02E0015-006	2378-TCDD	0.004	Yes	V	1.00	0.0035
BT38-002	02E0015-006	2378-TCDF	0.003	Yes	V	0.100	2.60E-04
BT38-002	02E0015-006	Heptachlorodibenzo-p-dioxin	0.013	Yes	V	0.010	1.30E-04
BT38-002	02E0015-006	OCDD	0.088	Yes	V	1.00E-04	8.80E-06
BT38-002	02E0015-006	OCDF	0.016	Yes	V	1.00E-04	1.60E-06
BT38-002	02E0015-006	Pentachlorodibenzo-p-dioxin	6.30E-04	Yes	V	1.00	6.30E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 02E0015-006:[c]							**0.005**
BT38-002	02E0015-007	1234678-HpCDF	0.003	Yes	V	0.010	3.40E-05
BT38-002	02E0015-007	1234789-HpCDF	3.20E-04	No	V	0.010	0
BT38-002	02E0015-007	123478-HxCDD	2.60E-04	No	V	0.100	0
BT38-002	02E0015-007	123478-HxCDF	6.70E-04	Yes	JB	0.100	6.70E-05
BT38-002	02E0015-007	123678-HxCDD	6.70E-04	Yes	V	0.100	6.70E-05
BT38-002	02E0015-007	123678-HxCDF	5.50E-04	Yes	JB	0.100	5.50E-05
BT38-002	02E0015-007	123789-HxCDD	6.70E-04	Yes	V	0.100	6.70E-05
BT38-002	02E0015-007	123789-HxCDF	1.80E-04	No	V	0.100	0
BT38-002	02E0015-007	12378-PeCDF	8.90E-04	Yes	V	0.050	4.45E-05
BT38-002	02E0015-007	234678-HxCDF	4.40E-04	Yes	V	0.100	4.40E-05
BT38-002	02E0015-007	23478-PeCDF	4.40E-04	Yes	V	0.500	2.20E-04
BT38-002	02E0015-007	2378-TCDD	0.007	Yes	V	1.00	0.0068
BT38-002	02E0015-007	2378-TCDF	0.004	Yes	V	0.100	4.20E-04
BT38-002	02E0015-007	Heptachlorodibenzo-p-dioxin	0.009	Yes	V	0.010	8.50E-05
BT38-002	02E0015-007	OCDD	0.057	Yes	V	1.00E-04	5.70E-06
BT38-002	02E0015-007	OCDF	0.004	Yes	JB	1.00E-04	3.70E-07
BT38-002	02E0015-007	Pentachlorodibenzo-p-dioxin	6.70E-04	Yes	V	1.00	6.70E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 02E0015-007:[c]							**0.009**
BT39-001	02E0015-001	1234678-HpCDF	0.006	Yes	V	0.010	6.20E-05
BT39-001	02E0015-001	1234789-HpCDF	1.50E-04	No	V	0.010	0
BT39-001	02E0015-001	123478-HxCDD	2.30E-04	Yes	JB	0.100	2.30E-05

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Table 1.3

Toxicity Equivalency Calculations for Dioxins/Furans - Wide-Ranging Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals	
						TEF[a]	TEQ Concentration[b]
BT39-001	02E0015-001	123478-HxCDF	6.80E-04	Yes	JB	0.100	6.80E-05
BT39-001	02E0015-001	123678-HxCDD	5.60E-04	Yes	V	0.100	5.60E-05
BT39-001	02E0015-001	123678-HxCDF	9.00E-04	Yes	JB	0.100	9.00E-05
BT39-001	02E0015-001	123789-HxCDD	4.50E-04	Yes	V	0.100	4.50E-05
BT39-001	02E0015-001	123789-HxCDF	9.50E-05	No	V	0.100	0
BT39-001	02E0015-001	12378-PeCDF	7.90E-04	Yes	V	0.050	3.95E-05
BT39-001	02E0015-001	234678-HxCDF	3.40E-04	Yes	V	0.100	3.40E-05
BT39-001	02E0015-001	23478-PeCDF	5.60E-04	Yes	V	0.500	2.80E-04
BT39-001	02E0015-001	2378-TCDD	0.004	Yes	V	1.00	0.0035
BT39-001	02E0015-001	2378-TCDF	0.004	Yes	V	0.100	3.60E-04
BT39-001	02E0015-001	Heptachlorodibenzo-p-dioxin	0.011	Yes	V	0.010	1.10E-04
BT39-001	02E0015-001	OCDD	0.084	Yes	V	1.00E-04	8.40E-06
BT39-001	02E0015-001	OCDF	0.005	Yes	JB	1.00E-04	5.10E-07
BT39-001	02E0015-001	Pentachlorodibenzo-p-dioxin	5.60E-04	Yes	V	1.00	5.60E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 02E0015-001:[c]							**0.005**
BT39-002	02E0015-002	1234678-HpCDF	0.004	Yes	V	0.010	3.80E-05
BT39-002	02E0015-002	1234789-HpCDF	3.40E-04	Yes	JB	0.010	3.40E-06
BT39-002	02E0015-002	123478-HxCDD	2.20E-04	Yes	JB	0.100	2.20E-05
BT39-002	02E0015-002	123478-HxCDF	4.50E-04	Yes	JB	0.100	4.50E-05
BT39-002	02E0015-002	123678-HxCDD	5.60E-04	Yes	V	0.100	5.60E-05
BT39-002	02E0015-002	123678-HxCDF	6.70E-04	Yes	JB	0.100	6.70E-05
BT39-002	02E0015-002	123789-HxCDD	7.90E-04	Yes	V	0.100	7.90E-05
BT39-002	02E0015-002	123789-HxCDF	2.20E-04	Yes	JB	0.100	2.20E-05
BT39-002	02E0015-002	12378-PeCDF	1.40E-04	No	V	0.050	0
BT39-002	02E0015-002	234678-HxCDF	3.40E-04	Yes	V	0.100	3.40E-05
BT39-002	02E0015-002	23478-PeCDF	1.40E-04	No	V	0.500	0
BT39-002	02E0015-002	2378-TCDD	0.002	Yes	V	1.00	0.0016
BT39-002	02E0015-002	2378-TCDF	7.90E-04	Yes	V	0.100	7.90E-05
BT39-002	02E0015-002	Heptachlorodibenzo-p-dioxin	0.014	Yes	V	0.010	1.40E-04
BT39-002	02E0015-002	OCDD	0.076	Yes	V	1.00E-04	7.60E-06
BT39-002	02E0015-002	OCDF	0.006	Yes	JB	1.00E-04	5.50E-07
BT39-002	02E0015-002	Pentachlorodibenzo-p-dioxin	4.50E-04	Yes	V	1.00	4.50E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 02E0015-002:[c]							**0.003**
BT39-003	02E0015-003	1234678-HpCDF	0.009	Yes	V	0.010	8.70E-05
BT39-003	02E0015-003	1234789-HpCDF	2.70E-04	No	V	0.010	0
BT39-003	02E0015-003	123478-HxCDD	4.70E-04	Yes	JB	0.100	4.70E-05
BT39-003	02E0015-003	123478-HxCDF	0.002	Yes	JB	0.100	1.50E-04
BT39-003	02E0015-003	123678-HxCDD	0.001	Yes	V	0.100	1.20E-04
BT39-003	02E0015-003	123678-HxCDF	0.001	Yes	JB	0.100	1.20E-04
BT39-003	02E0015-003	123789-HxCDD	0.001	Yes	V	0.100	1.10E-04
BT39-003	02E0015-003	123789-HxCDF	1.50E-04	No	V	0.100	0
BT39-003	02E0015-003	12378-PeCDF	0.004	Yes	V	0.050	2.15E-04
BT39-003	02E0015-003	234678-HxCDF	8.20E-04	Yes	V	0.100	8.20E-05
BT39-003	02E0015-003	23478-PeCDF	0.002	Yes	V	0.500	9.50E-04
BT39-003	02E0015-003	2378-TCDD	0.007	Yes	V	1.00	0.0066
BT39-003	02E0015-003	2378-TCDF	0.012	Yes	V	0.100	0.0012
BT39-003	02E0015-003	Heptachlorodibenzo-p-dioxin	0.033	Yes	V	0.010	3.30E-04
BT39-003	02E0015-003	OCDD	0.290	Yes	V	1.00E-04	2.90E-05
BT39-003	02E0015-003	OCDF	0.011	Yes	V	1.00E-04	1.10E-06
BT39-003	02E0015-003	Pentachlorodibenzo-p-dioxin	8.20E-04	Yes	V	1.00	8.20E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 02E0015-003:[c]							**0.011**
BT39-004	02E0015-004	1234678-HpCDF	0.001	Yes	JB	0.010	1.40E-05
BT39-004	02E0015-004	1234789-HpCDF	3.50E-04	No	V	0.010	0
BT39-004	02E0015-004	123478-HxCDD	2.50E-04	No	V	0.100	0
BT39-004	02E0015-004	123478-HxCDF	1.20E-04	No	V	0.100	0
BT39-004	02E0015-004	123678-HxCDD	2.30E-04	No	V	0.100	0
BT39-004	02E0015-004	123678-HxCDF	1.10E-04	No	V	0.100	0
BT39-004	02E0015-004	123789-HxCDD	2.40E-04	No	V	0.100	0

Table 1.3

Toxicity Equivalency Calculations for Dioxins/Furans - Wide-Ranging Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals	
						TEF[a]	TEQ Concentration[b]
BT39-004	02E0015-004	123789-HxCDF	1.40E-04	No	V	0.100	0
BT39-004	02E0015-004	12378-PeCDF	2.30E-04	No	V	0.050	0
BT39-004	02E0015-004	234678-HxCDF	1.30E-04	No	V	0.100	0
BT39-004	02E0015-004	23478-PeCDF	2.20E-04	No	V	0.500	0
BT39-004	02E0015-004	2378-TCDD	0.002	Yes	V	1.00	0.0016
BT39-004	02E0015-004	2378-TCDF	7.60E-04	Yes	V	0.100	7.60E-05
BT39-004	02E0015-004	Heptachlorodibenzo-p-dioxin	0.003	Yes	V	0.010	2.80E-05
BT39-004	02E0015-004	OCDD	0.018	Yes	V	1.00E-04	1.80E-06
BT39-004	02E0015-004	OCDF	0.002	Yes	JB	1.00E-04	2.00E-07
BT39-004	02E0015-004	Pentachlorodibenzo-p-dioxin	2.50E-04	No	V	1.00	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 02E0015-004:[c]							**0.002**
CB43-034	04F1620-005	1234678-HpCDF	0.020	Yes	V1	0.010	2.00E-04
CB43-034	04F1620-005	1234789-HpCDF	0.004	Yes	JB1	0.010	3.50E-05
CB43-034	04F1620-005	123478-HxCDD	0.002	Yes	JB1	0.100	1.70E-04
CB43-034	04F1620-005	123478-HxCDF	0.013	Yes	V1	0.100	0.0013
CB43-034	04F1620-005	123678-HxCDD	0.005	Yes	JB1	0.100	5.10E-04
CB43-034	04F1620-005	123678-HxCDF	0.005	Yes	V1	0.100	4.90E-04
CB43-034	04F1620-005	123789-HxCDD	0.004	Yes	JB1	0.100	3.60E-04
CB43-034	04F1620-005	123789-HxCDF	1.60E-04	Yes	JB1	0.100	1.60E-05
CB43-034	04F1620-005	12378-PeCDF	0.002	Yes	JB1	0.050	1.05E-04
CB43-034	04F1620-005	234678-HxCDF	0.002	Yes	JB1	0.100	1.90E-04
CB43-034	04F1620-005	23478-PeCDF	0.007	Yes	V1	0.500	0.00335
CB43-034	04F1620-005	2378-TCDD	0.002	Yes	V1	1.00	0.0019
CB43-034	04F1620-005	2378-TCDF	0.016	Yes	V1	0.100	0.0016
CB43-034	04F1620-005	Heptachlorodibenzo-p-dioxin	0.095	Yes	V1	0.010	9.50E-04
CB43-034	04F1620-005	OCDD	0.630	Yes	V1	1.00E-04	6.30E-05
CB43-034	04F1620-005	OCDF	0.036	Yes	V1	1.00E-04	3.60E-06
CB43-034	04F1620-005	Pentachlorodibenzo-p-dioxin	7.90E-04	Yes	JB1	1.00	7.90E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 04F1620-005:[c]							**0.012**
CB43-038	04F0770-013	1234678-HpCDF	0.016	Yes	V	0.010	1.59E-04
CB43-038	04F0770-013	1234789-HpCDF	0.002	Yes	V	0.010	1.86E-05
CB43-038	04F0770-013	123478-HxCDD	0.001	Yes	V	0.100	1.43E-04
CB43-038	04F0770-013	123478-HxCDF	0.017	Yes	V	0.100	0.00168
CB43-038	04F0770-013	123678-HxCDD	0.004	Yes	V	0.100	4.31E-04
CB43-038	04F0770-013	123678-HxCDF	0.006	Yes	V	0.100	6.27E-04
CB43-038	04F0770-013	123789-HxCDD	0.003	Yes	V	0.100	2.85E-04
CB43-038	04F0770-013	123789-HxCDF	2.91E-04	Yes	V	0.100	2.91E-05
CB43-038	04F0770-013	12378-PeCDF	0.011	Yes	V	0.050	5.55E-04
CB43-038	04F0770-013	234678-HxCDF	0.003	Yes	V	0.100	2.59E-04
CB43-038	04F0770-013	23478-PeCDF	0.018	Yes	V	0.500	0.00895
CB43-038	04F0770-013	2378-TCDD	4.32E-04	No	V	1.00	0
CB43-038	04F0770-013	2378-TCDF	0.050	Yes	V	0.100	0.00496
CB43-038	04F0770-013	Heptachlorodibenzo-p-dioxin	0.065	Yes	V	0.010	6.46E-04
CB43-038	04F0770-013	OCDD	0.408	Yes	V	1.00E-04	4.08E-05
CB43-038	04F0770-013	OCDF	0.017	Yes	V	1.00E-04	1.73E-06
CB43-038	04F0770-013	Pentachlorodibenzo-p-dioxin	0.001	No	V	1.00	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 04F0770-013:[c]							**0.019**
CB44-013	04F1558-010	1234678-HpCDF	0.006	Yes	JB1	0.010	6.40E-05
CB44-013	04F1558-010	1234789-HpCDF	5.10E-04	Yes	JB1	0.010	5.10E-06
CB44-013	04F1558-010	123478-HxCDD	4.10E-04	Yes	JB1	0.100	4.10E-05
CB44-013	04F1558-010	123478-HxCDF	0.001	Yes	JB1	0.100	1.30E-04
CB44-013	04F1558-010	123678-HxCDD	0.002	Yes	JB1	0.100	2.10E-04
CB44-013	04F1558-010	123678-HxCDF	4.80E-04	Yes	JB1	0.100	4.80E-05
CB44-013	04F1558-010	123789-HxCDD	0.001	Yes	JB1	0.100	1.30E-04
CB44-013	04F1558-010	123789-HxCDF	1.80E-04	No	V1	0.100	0
CB44-013	04F1558-010	12378-PeCDF	1.60E-04	No	V1	0.050	0
CB44-013	04F1558-010	234678-HxCDF	3.10E-04	Yes	JB1	0.100	3.10E-05
CB44-013	04F1558-010	23478-PeCDF	3.90E-04	Yes	JB1	0.500	1.95E-04

Table 1.3

Toxicity Equivalency Calculations for Dioxins/Furans - Wide-Ranging Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals	
						TEF[a]	TEQ Concentration[b]
CB44-013	04F1558-010	2378-TCDD	3.00E-04	No	V1	1.00	0
CB44-013	04F1558-010	2378-TCDF	9.50E-04	Yes	V1	0.100	9.50E-05
CB44-013	04F1558-010	Heptachlorodibenzo-p-dioxin	0.033	Yes	V1	0.010	3.30E-04
CB44-013	04F1558-010	OCDD	0.220	Yes	V1	1.00E-04	2.20E-05
CB44-013	04F1558-010	OCDF	0.011	Yes	V1	1.00E-04	1.10E-06
CB44-013	04F1558-010	Pentachlorodibenzo-p-dioxin	3.60E-04	Yes	JB1	1.00	3.60E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 04F1558-010:[c]							**0.002**
CB44-017	04F1556-001	1234678-HpCDF	0.004	Yes	JB	0.010	3.70E-05
CB44-017	04F1556-001	1234789-HpCDF	2.60E-04	No	V	0.010	0
CB44-017	04F1556-001	123478-HxCDD	4.40E-04	Yes	JB	0.100	4.40E-05
CB44-017	04F1556-001	123478-HxCDF	1.00E-03	Yes	JB	0.100	1.00E-04
CB44-017	04F1556-001	123678-HxCDD	0.002	Yes	JB	0.100	1.80E-04
CB44-017	04F1556-001	123678-HxCDF	3.10E-04	Yes	JB	0.100	3.10E-05
CB44-017	04F1556-001	123789-HxCDD	0.001	Yes	JB	0.100	1.20E-04
CB44-017	04F1556-001	123789-HxCDF	1.90E-04	No	V	0.100	0
CB44-017	04F1556-001	12378-PeCDF	1.70E-04	No	V	0.050	0
CB44-017	04F1556-001	234678-HxCDF	5.00E-04	Yes	JB	0.100	5.00E-05
CB44-017	04F1556-001	23478-PeCDF	3.00E-04	Yes	JB	0.500	1.50E-04
CB44-017	04F1556-001	2378-TCDD	2.80E-04	No	V	1.00	0
CB44-017	04F1556-001	2378-TCDF	3.20E-04	No	V	0.100	0
CB44-017	04F1556-001	Heptachlorodibenzo-p-dioxin	0.030	Yes	V	0.010	3.00E-04
CB44-017	04F1556-001	OCDD	0.210	Yes	J	1.00E-04	2.10E-05
CB44-017	04F1556-001	OCDF	0.005	Yes	JB	1.00E-04	5.10E-07
CB44-017	04F1556-001	Pentachlorodibenzo-p-dioxin	2.00E-04	No	V	1.00	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 04F1556-001:[c]							**0.001**
CC44-005	04F1372-008	1234678-HpCDF	7.20E-04	Yes	JB	0.010	7.20E-06
CC44-005	04F1372-008	1234789-HpCDF	9.30E-04	Yes	JB	0.010	9.30E-06
CC44-005	04F1372-008	123478-HxCDD	2.00E-04	No	V	0.100	0
CC44-005	04F1372-008	123478-HxCDF	1.50E-04	No	V	0.100	0
CC44-005	04F1372-008	123678-HxCDD	3.90E-04	Yes	V	0.100	3.90E-05
CC44-005	04F1372-008	123678-HxCDF	1.70E-04	Yes	JB	0.100	1.70E-05
CC44-005	04F1372-008	123789-HxCDD	2.00E-04	No	V	0.100	0
CC44-005	04F1372-008	123789-HxCDF	2.20E-04	No	V	0.100	0
CC44-005	04F1372-008	12378-PeCDF	1.30E-04	No	V	0.050	0
CC44-005	04F1372-008	234678-HxCDF	1.60E-04	No	V	0.100	0
CC44-005	04F1372-008	23478-PeCDF	1.30E-04	No	V	0.500	0
CC44-005	04F1372-008	2378-TCDD	2.50E-04	No	V	1.00	0
CC44-005	04F1372-008	2378-TCDF	2.70E-04	No	V	0.100	0
CC44-005	04F1372-008	Heptachlorodibenzo-p-dioxin	0.005	Yes	V	0.010	5.10E-05
CC44-005	04F1372-008	OCDD	0.042	No	UJ	1.00E-04	0
CC44-005	04F1372-008	OCDF	0.004	Yes	JB	1.00E-04	4.10E-07
CC44-005	04F1372-008	Pentachlorodibenzo-p-dioxin	1.70E-04	No	V	1.00	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 04F1372-008:[c]							**1.24E-04**
BI31-008	03F0329-006	1234678-HpCDF	0.009	Yes	V	0.010	9.20E-05
BI31-008	03F0329-006	1234789-HpCDF	0.001	Yes	JB	0.010	1.20E-05
BI31-008	03F0329-006	123478-HxCDD	5.00E-04	Yes	JB	0.100	5.00E-05
BI31-008	03F0329-006	123478-HxCDF	0.005	Yes	V	0.100	5.20E-04
BI31-008	03F0329-006	123678-HxCDD	0.001	Yes	JB	0.100	1.10E-04
BI31-008	03F0329-006	123678-HxCDF	0.002	Yes	JB	0.100	1.80E-04
BI31-008	03F0329-006	123789-HxCDD	0.001	Yes	JB	0.100	1.20E-04
BI31-008	03F0329-006	123789-HxCDF	1.90E-04	Yes	JB	0.100	1.90E-05
BI31-008	03F0329-006	12378-PeCDF	0.002	Yes	JB	0.050	9.00E-05
BI31-008	03F0329-006	234678-HxCDF	0.002	Yes	JB	0.100	2.00E-04
BI31-008	03F0329-006	23478-PeCDF	0.003	Yes	JB	0.500	0.002
BI31-008	03F0329-006	2378-TCDD	3.80E-04	Yes	V	1.00	3.80E-04
BI31-008	03F0329-006	2378-TCDF	0.003	Yes	V	0.100	2.90E-04
BI31-008	03F0329-006	Heptachlorodibenzo-p-dioxin	0.017	Yes	V	0.010	1.70E-04
BI31-008	03F0329-006	OCDD	0.130	Yes	V	1.00E-04	1.30E-05

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Table 1.3

Toxicity Equivalency Calculations for Dioxins/Furans - Wide-Ranging Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals	
						TEF[a]	TEQ Concentration[b]
BI31-008	03F0329-006	OCDF	0.012	Yes	V	1.00E-04	1.20E-06
BI31-008	03F0329-006	Pentachlorodibenzo-p-dioxin	4.00E-04	Yes	JB	1.00	4.00E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-006:[c]							**0.004**
BI31-009-01	03F0329-004	1234678-HpCDF	0.003	Yes	V	0.010	2.60E-05
BI31-009-01	03F0329-004	1234789-HpCDF	4.40E-04	Yes	JB	0.010	4.40E-06
BI31-009-01	03F0329-004	123478-HxCDD	1.70E-04	No	V	0.100	0
BI31-009-01	03F0329-004	123478-HxCDF	0.001	Yes	V	0.100	1.20E-04
BI31-009-01	03F0329-004	123678-HxCDD	4.10E-04	Yes	JB	0.100	4.10E-05
BI31-009-01	03F0329-004	123678-HxCDF	4.40E-04	Yes	JB	0.100	4.40E-05
BI31-009-01	03F0329-004	123789-HxCDD	3.90E-04	Yes	JB	0.100	3.90E-05
BI31-009-01	03F0329-004	123789-HxCDF	1.10E-04	No	V	0.100	0
BI31-009-01	03F0329-004	12378-PeCDF	2.90E-04	Yes	JB	0.050	1.45E-05
BI31-009-01	03F0329-004	234678-HxCDF	5.50E-04	Yes	JB	0.100	5.50E-05
BI31-009-01	03F0329-004	23478-PeCDF	6.40E-04	Yes	JB	0.500	3.20E-04
BI31-009-01	03F0329-004	2378-TCDD	2.90E-04	No	V	1.00	0
BI31-009-01	03F0329-004	2378-TCDF	8.70E-04	Yes	V	0.100	8.70E-05
BI31-009-01	03F0329-004	Heptachlorodibenzo-p-dioxin	0.007	Yes	V	0.010	6.80E-05
BI31-009-01	03F0329-004	OCDD	0.054	Yes	V	1.00E-04	5.40E-06
BI31-009-01	03F0329-004	OCDF	0.005	Yes	V	1.00E-04	4.50E-07
BI31-009-01	03F0329-004	Pentachlorodibenzo-p-dioxin	1.40E-04	No	V	1.00	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-004:[c]							**8.25E-04**
BI31-010	03F0329-002	1234678-HpCDF	0.051	Yes	V	0.010	5.10E-04
BI31-010	03F0329-002	1234789-HpCDF	0.003	Yes	V	0.010	3.00E-05
BI31-010	03F0329-002	123478-HxCDD	0.001	Yes	JB	0.100	1.20E-04
BI31-010	03F0329-002	123478-HxCDF	0.027	Yes	V	0.100	0.003
BI31-010	03F0329-002	123678-HxCDD	0.002	Yes	V	0.100	1.90E-04
BI31-010	03F0329-002	123678-HxCDF	0.010	Yes	V	0.100	1.00E-03
BI31-010	03F0329-002	123789-HxCDD	0.003	Yes	V	0.100	2.70E-04
BI31-010	03F0329-002	123789-HxCDF	4.70E-04	Yes	JB	0.100	4.70E-05
BI31-010	03F0329-002	12378-PeCDF	0.005	Yes	V	0.050	2.70E-04
BI31-010	03F0329-002	234678-HxCDF	0.008	Yes	V	0.100	8.10E-04
BI31-010	03F0329-002	23478-PeCDF	0.008	Yes	V	0.500	0.004
BI31-010	03F0329-002	2378-TCDD	2.30E-04	Yes	V	1.00	2.30E-04
BI31-010	03F0329-002	2378-TCDF	0.005	Yes	V	0.100	4.60E-04
BI31-010	03F0329-002	Heptachlorodibenzo-p-dioxin	0.016	Yes	V	0.010	1.60E-04
BI31-010	03F0329-002	OCDD	0.090	Yes	V	1.00E-04	9.00E-06
BI31-010	03F0329-002	OCDF	0.020	Yes	V	1.00E-04	2.00E-06
BI31-010	03F0329-002	Pentachlorodibenzo-p-dioxin	7.60E-04	Yes	JB	1.00	7.60E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-002:[c]							**0.011**
BI31-011	03F0329-003	1234678-HpCDF	0.240	Yes	V	0.010	0.002
BI31-011	03F0329-003	1234789-HpCDF	0.025	Yes	V	0.010	2.50E-04
BI31-011	03F0329-003	123478-HxCDD	0.007	Yes	V	0.100	7.30E-04
BI31-011	03F0329-003	123478-HxCDF	0.140	Yes	V	0.100	0.014
BI31-011	03F0329-003	123678-HxCDD	0.012	Yes	V	0.100	0.001
BI31-011	03F0329-003	123678-HxCDF	0.043	Yes	V	0.100	0.004
BI31-011	03F0329-003	123789-HxCDD	0.021	Yes	V	0.100	0.002
BI31-011	03F0329-003	123789-HxCDF	0.003	Yes	V	0.100	2.50E-04
BI31-011	03F0329-003	12378-PeCDF	0.028	Yes	V	0.050	0.001
BI31-011	03F0329-003	234678-HxCDF	0.063	Yes	V	0.100	0.006
BI31-011	03F0329-003	23478-PeCDF	0.056	Yes	V	0.500	0.028
BI31-011	03F0329-003	2378-TCDD	0.002	Yes	V	1.00	0.002
BI31-011	03F0329-003	2378-TCDF	0.028	Yes	V	0.100	0.003
BI31-011	03F0329-003	Heptachlorodibenzo-p-dioxin	0.110	Yes	V	0.010	0.001
BI31-011	03F0329-003	OCDD	0.390	Yes	V	1.00E-04	3.90E-05
BI31-011	03F0329-003	OCDF	0.140	Yes	V	1.00E-04	1.40E-05
BI31-011	03F0329-003	Pentachlorodibenzo-p-dioxin	0.007	Yes	V	1.00	0.007
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-003:[c]							**0.074**
BI31-012	03F2087-001	1234678-HpCDF	0.006	Yes	VI	0.010	6.10E-05

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Table 1.3

Toxicity Equivalency Calculations for Dioxins/Furans - Wide-Ranging Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals	
						TEF[a]	TEQ Concentration[b]
BI31-012	03F2087-001	1234789-HpCDF	8.80E-04	Yes	V1	0.010	8.80E-06
BI31-012	03F2087-001	123478-HxCDD	3.40E-04	Yes	V1	0.100	3.40E-05
BI31-012	03F2087-001	123478-HxCDF	0.003	Yes	V1	0.100	2.70E-04
BI31-012	03F2087-001	123678-HxCDD	1.00E-03	Yes	V1	0.100	1.00E-04
BI31-012	03F2087-001	123678-HxCDF	9.20E-04	Yes	V1	0.100	9.20E-05
BI31-012	03F2087-001	123789-HxCDD	1.00E-03	Yes	V1	0.100	1.00E-04
BI31-012	03F2087-001	123789-HxCDF	1.40E-04	No	V1	0.100	0
BI31-012	03F2087-001	12378-PeCDF	6.20E-04	Yes	V1	0.050	3.10E-05
BI31-012	03F2087-001	234678-HxCDF	0.001	Yes	V1	0.100	1.20E-04
BI31-012	03F2087-001	23478-PeCDF	1.00E-03	Yes	V1	0.500	5.00E-04
BI31-012	03F2087-001	2378-TCDD	5.50E-04	Yes	V1	1.00	5.50E-04
BI31-012	03F2087-001	2378-TCDF	1.00E-03	Yes	V1	0.100	1.00E-04
BI31-012	03F2087-001	Heptachlorodibenzo-p-dioxin	0.015	Yes	V1	0.010	1.50E-04
BI31-012	03F2087-001	OCDD	0.130	Yes	V1	1.00E-04	1.30E-05
BI31-012	03F2087-001	OCDF	0.011	Yes	V1	1.00E-04	1.10E-06
BI31-012	03F2087-001	Pentachlorodibenzo-p-dioxin	3.20E-04	Yes	V1	1.00	3.20E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-001:[c]							**0.002**
BI31-013	03F2087-002	1234678-HpCDF	0.016	Yes	V1	0.010	1.60E-04
BI31-013	03F2087-002	1234789-HpCDF	0.001	Yes	V1	0.010	1.40E-05
BI31-013	03F2087-002	123478-HxCDD	5.90E-04	Yes	V1	0.100	5.90E-05
BI31-013	03F2087-002	123478-HxCDF	0.009	Yes	V1	0.100	8.50E-04
BI31-013	03F2087-002	123678-HxCDD	0.001	Yes	V1	0.100	1.20E-04
BI31-013	03F2087-002	123678-HxCDF	0.003	Yes	V1	0.100	3.30E-04
BI31-013	03F2087-002	123789-HxCDD	0.002	Yes	V1	0.100	1.60E-04
BI31-013	03F2087-002	123789-HxCDF	2.90E-04	Yes	V1	0.100	2.90E-05
BI31-013	03F2087-002	12378-PeCDF	0.002	Yes	V1	0.050	1.10E-04
BI31-013	03F2087-002	234678-HxCDF	0.004	Yes	V1	0.100	4.00E-04
BI31-013	03F2087-002	23478-PeCDF	0.004	Yes	V1	0.500	0.002
BI31-013	03F2087-002	2378-TCDD	6.10E-04	Yes	V1	1.00	6.10E-04
BI31-013	03F2087-002	2378-TCDF	0.002	Yes	V1	0.100	2.20E-04
BI31-013	03F2087-002	Heptachlorodibenzo-p-dioxin	0.015	Yes	V1	0.010	1.50E-04
BI31-013	03F2087-002	OCDD	0.085	Yes	V1	1.00E-04	8.50E-06
BI31-013	03F2087-002	OCDF	0.012	Yes	V1	1.00E-04	1.20E-06
BI31-013	03F2087-002	Pentachlorodibenzo-p-dioxin	5.60E-04	Yes	V1	1.00	5.60E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-002:[c]							**0.006**
BI31-015	04F0058-001	1234678-HpCDF	0.003	No	V	0.010	0
BI31-015	04F0058-001	1234789-HpCDF	0.003	No	V	0.010	0
BI31-015	04F0058-001	123478-HxCDD	0.003	No	V	0.100	0
BI31-015	04F0058-001	123478-HxCDF	0.003	No	V	0.100	0
BI31-015	04F0058-001	123678-HxCDD	0.003	No	V	0.100	0
BI31-015	04F0058-001	123678-HxCDF	0.003	No	V	0.100	0
BI31-015	04F0058-001	123789-HxCDD	0.003	No	V	0.100	0
BI31-015	04F0058-001	123789-HxCDF	0.003	No	V	0.100	0
BI31-015	04F0058-001	12378-PeCDF	0.003	No	V	0.050	0
BI31-015	04F0058-001	234678-HxCDF	0.003	No	V	0.100	0
BI31-015	04F0058-001	23478-PeCDF	0.003	No	V	0.500	0
BI31-015	04F0058-001	2378-TCDD	0.001	No	V	1.00	0
BI31-015	04F0058-001	2378-TCDF	0.001	No	V	0.100	0
BI31-015	04F0058-001	Heptachlorodibenzo-p-dioxin	0.003	No	V	0.010	0
BI31-015	04F0058-001	OCDD	4.15E-04	Yes	JB	1.00E-04	4.15E-08
BI31-015	04F0058-001	OCDF	7.19E-05	Yes	V	1.00E-04	7.19E-09
BI31-015	04F0058-001	Pentachlorodibenzo-p-dioxin	0.003	No	V	1.00	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 04F0058-001:[c]							**4.87E-08**
BI31-016	04F0058-002	1234678-HpCDF	2.35E-04	Yes	V	0.010	2.35E-06
BI31-016	04F0058-002	1234789-HpCDF	0.003	No	V	0.010	0
BI31-016	04F0058-002	123478-HxCDD	0.003	No	V	0.100	0
BI31-016	04F0058-002	123478-HxCDF	0.003	No	V	0.100	0
BI31-016	04F0058-002	123678-HxCDD	0.003	No	V	0.100	0

Table 1.3

Toxicity Equivalency Calculations for Dioxins/Furans - Wide-Ranging Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals	
						TEF[a]	TEQ Concentration[b]
BI31-016	04F0058-002	123678-HxCDF	0.003	No	V	0.100	0
BI31-016	04F0058-002	123789-HxCDD	2.20E-04	Yes	V	0.100	2.20E-05
BI31-016	04F0058-002	123789-HxCDF	0.003	No	V	0.100	0
BI31-016	04F0058-002	12378-PeCDF	0.003	No	V	0.050	0
BI31-016	04F0058-002	234678-HxCDF	0.003	No	V	0.100	0
BI31-016	04F0058-002	23478-PeCDF	0.003	No	V	0.500	0
BI31-016	04F0058-002	2378-TCDD	2.59E-05	Yes	V	1.00	2.59E-05
BI31-016	04F0058-002	2378-TCDF	0.001	No	V	0.100	0
BI31-016	04F0058-002	Heptachlorodibenzo-p-dioxin	2.48E-04	Yes	V	0.010	2.48E-06
BI31-016	04F0058-002	OCDD	0.002	Yes	JB	1.00E-04	2.08E-07
BI31-016	04F0058-002	OCDF	3.58E-04	Yes	V	1.00E-04	3.58E-08
BI31-016	04F0058-002	Pentachlorodibenzo-p-dioxin	0.003	No	V	1.00	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample04F0058-002:[c]							**5.30E-05**
BJ31-005	03F2087-004	1234678-HpCDF	0.010	Yes	V1	0.010	9.90E-05
BJ31-005	03F2087-004	1234789-HpCDF	7.10E-04	Yes	V1	0.010	7.10E-06
BJ31-005	03F2087-004	123478-HxCDD	7.20E-04	Yes	V1	0.100	7.20E-05
BJ31-005	03F2087-004	123478-HxCDF	0.005	Yes	V1	0.100	4.80E-04
BJ31-005	03F2087-004	123678-HxCDD	0.001	Yes	V1	0.100	1.40E-04
BJ31-005	03F2087-004	123678-HxCDF	0.002	Yes	V1	0.100	1.80E-04
BJ31-005	03F2087-004	123789-HxCDD	0.001	Yes	V1	0.100	1.20E-04
BJ31-005	03F2087-004	123789-HxCDF	2.60E-04	No	V1	0.100	0
BJ31-005	03F2087-004	12378-PeCDF	0.001	Yes	V1	0.050	5.50E-05
BJ31-005	03F2087-004	234678-HxCDF	0.002	Yes	V1	0.100	2.20E-04
BJ31-005	03F2087-004	23478-PeCDF	0.002	Yes	V1	0.500	8.50E-04
BJ31-005	03F2087-004	2378-TCDD	2.80E-04	Yes	V1	1.00	2.80E-04
BJ31-005	03F2087-004	2378-TCDF	0.001	Yes	V1	0.100	1.20E-04
BJ31-005	03F2087-004	Heptachlorodibenzo-p-dioxin	0.020	Yes	V1	0.010	2.00E-04
BJ31-005	03F2087-004	OCDD	0.170	Yes	J1	1.00E-04	1.70E-05
BJ31-005	03F2087-004	OCDF	0.011	Yes	V1	1.00E-04	1.10E-06
BJ31-005	03F2087-004	Pentachlorodibenzo-p-dioxin	4.50E-04	Yes	V1	1.00	4.50E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-004:[c]							**0.003**
BJ31-006	03F2087-005	1234678-HpCDF	0.013	Yes	V1	0.010	1.30E-04
BJ31-006	03F2087-005	1234789-HpCDF	0.001	Yes	V1	0.010	1.30E-05
BJ31-006	03F2087-005	123478-HxCDD	5.50E-04	Yes	V1	0.100	5.50E-05
BJ31-006	03F2087-005	123478-HxCDF	0.005	Yes	V1	0.100	5.40E-04
BJ31-006	03F2087-005	123678-HxCDD	0.002	Yes	V1	0.100	1.60E-04
BJ31-006	03F2087-005	123678-HxCDF	0.002	Yes	V1	0.100	2.10E-04
BJ31-006	03F2087-005	123789-HxCDD	0.001	Yes	V1	0.100	1.20E-04
BJ31-006	03F2087-005	123789-HxCDF	3.60E-04	No	V1	0.100	0
BJ31-006	03F2087-005	12378-PeCDF	0.001	Yes	V1	0.050	6.50E-05
BJ31-006	03F2087-005	234678-HxCDF	0.003	Yes	V1	0.100	2.50E-04
BJ31-006	03F2087-005	23478-PeCDF	0.002	Yes	V1	0.500	1.00E-03
BJ31-006	03F2087-005	2378-TCDD	2.20E-04	No	V1	1.00	0
BJ31-006	03F2087-005	2378-TCDF	0.001	Yes	V1	0.100	1.30E-04
BJ31-006	03F2087-005	Heptachlorodibenzo-p-dioxin	0.020	Yes	V1	0.010	2.00E-04
BJ31-006	03F2087-005	OCDD	0.150	Yes	J1	1.00E-04	1.50E-05
BJ31-006	03F2087-005	OCDF	0.012	Yes	V1	1.00E-04	1.20E-06
BJ31-006	03F2087-005	Pentachlorodibenzo-p-dioxin	6.20E-04	Yes	V1	1.00	6.20E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-005:[c]							**0.004**
2,3,7,8-TCDD TEQ Concentration used in Surface Soil ESL Screen[c]:							**0.074**

[a] Toxicity Equivalency Factor (WHO, 1997).

[b] TEQ (Toxicity Equivalence) Concentration = Soil Concentration x TEF. For non-detects, the TEQ Concentration equals zero.

[c] The 2,3,7,8-TCDD TEQ concentration used in the ESL screen is the maximum of all sampling locations for the medium.

N/A = Not Applicable.

Table 2.1
Comparison of MDCs in Surface Soil to NOAEL ESLs for Wide-Ranging Receptors

Analyte	MDC	Mule Deer		Coyote Carnivore		Coyote Generalist		Coyote Insectivore		Terrestrial Receptor[a]		Most Sensitive Receptor	Retain for Further Analysis?
		NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?		
Inorganics (mg/kg)													
Aluminum	61,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Ammonia	4.81	37,008	No	2,247	No	2,311	No	2,539	No	N/A	N/A	Coyote Carnivore	No
Antimony	348	**58**	**Yes**	**138**	**Yes**	**13**	**Yes**	**3.9**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
Arsenic	56.2	**13**	**Yes**	709	No	341	No	293	No	N/A	N/A	Mule Deer	**Yes**
Barium	1500	4,766	No	24,896	No	19,838	No	18,369	No	N/A	N/A	Mule Deer	No
Beryllium	26.8	896	No	1,072	No	103	No	29	No	N/A	N/A	Coyote Insectivore	No
Boron	28	314	No	929	No	6,070	No	1,816	No	N/A	N/A	Mule Deer	No
Cadmium	270	723	No	1,360	No	51	**Yes**	**10**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
Calcium	210,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Cesium	18.8		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Chromium[b]	210	1,461	No	4,173	No	250	No	**69**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
Chromium VI	0.85	1,461	No	4,173	No	250	No	69	No	N/A	N/A	Coyote Insectivore	No
Cobalt	137	7,902	No	3,785	No	2,492	No	1,519	No	N/A	N/A	Coyote Insectivore	No
Copper	1,860	4,119	No	5,459	No	3,000	No	4,641	No	N/A	N/A	Coyote Generalist	No
Cyanide	0.29	3,071	No	4,455	No	4,232	No	4,411	No	N/A	N/A	Mule Deer	No
Fluoride	3.61	1,200	No	73	No	75	No	82	No	N/A	N/A	Coyote Carnivore	No
Iron	130,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Lead	814	9,798	No	8,927	No	3,066	No	1,393	No	N/A	N/A	Coyote Insectivore	No
Lithium	50	10,173	No	18,431	No	5,608	No	2,560	No	N/A	N/A	Coyote Insectivore	No
Magnesium	30,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Manganese	2,220	2,506	No	14,051	No	10,939	No	19,115	No	N/A	N/A	Mule Deer	No
Mercury	48	**7.6**	**Yes**	**8**	**Yes**	**8.5**	**Yes**	**37**	**Yes**	N/A	N/A	Mule Deer	**Yes**
Molybdenum	19.1	44	No	275	No	29	No	**8.2**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
Nickel	280	**124**	**Yes**	**91**	**Yes**	**6.0**	**Yes**	**1.9**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
Nitrate / Nitrite	765	22,660	No	32,879	No	32,190	No	32,879	No	N/A	N/A	Mule Deer	No
Nitrite	2		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Potassium	8,310		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Selenium	2.2	3.8	No	32	No	12	No	5.4	No	N/A	N/A	Mule Deer	No
Silica	1,880		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Silicon	11,300		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Silver	364		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Sodium	6,600		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Strontium	413	4,702	No	584,444	No	144,904	No	57,298	No	N/A	N/A	Mule Deer	No
Thallium	5.8	1,039	No	212	No	82	No	31	No	N/A	N/A	Coyote Insectivore	No
Tin	161	242	No	**70**	**Yes**	**36**	**Yes**	**16**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
Titanium	1,730		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Uranium	370	5,472	No	7,299	No	3,106	No	2,272	No	N/A	N/A	Coyote Insectivore	No
Vanadium	5,300	**358**	**Yes**	**341**	**Yes**	**164**	**Yes**	**121**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
Zinc	11,900	**2,772**	**Yes**	16,489	No	**3,887**	**Yes**	**431**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
Organics (µg/kg)													
1,1,1-Trichloroethane	47.7	69,888,175	No	2,346,043	No	2,354,792	No	2,388,946	No	N/A	N/A	Coyote Carnivore	No
1,1,2,2-Tetrachloroethane	1.39	6,702,513	No	253,233	No	255,398	No	262,963	No	N/A	N/A	Coyote Carnivore	No
1,1,2-Trichloro-1,2,2-trifluoroethane	1.83		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT

Table 2.1
Comparison of MDCs in Surface Soil to NOAEL ESLs for Wide-Ranging Receptors

Analyte	MDC	Mule Deer		Coyote Carnivore		Coyote Generalist		Coyote Insectivore		Terrestrial Receptor		Most Sensitive Receptor	Retain for Further Analysis?
		NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?		
1,1-Dichloroethene	7.9	1,829,048	No	70,334	No	70,986	No	73,253	No	N/A	N/A	Coyote Carnivore	No
1,2,3-Trichlorobenzene	1.7		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
1,2,3-Trichloropropane	1.47	1,672,487	No	58,642	No	58,965	No	60,144	No	N/A	N/A	Coyote Carnivore	No
1,2,4-Trichlorobenzene	150	140,112	No	3,471	No	3,441	No	3,367	No	N/A	N/A	Coyote Insectivore	No
1,2,4-Trimethylbenzene	1,300		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
1,2-Dichloroethene	16	2,662,965	No	105,941	No	107,072	No	110,973	No	N/A	N/A	Coyote Carnivore	No
1,2-Dichloropropane	140	5,601,411	No	208,701	No	210,366	No	216,215	No	N/A	N/A	Coyote Carnivore	No
1,3,5-Trimethylbenzene	490	1,259,077	No	33,545	No	33,359	No	32,915	No	N/A	N/A	Coyote Insectivore	No
1,4-Dichlorobenzene	110	8,654,785	No	251,050	No	250,513	No	249,682	No	N/A	N/A	Coyote Insectivore	No
2,4,5-T	1.8	24,148	No	704	No	703	No	701	No	N/A	N/A	Coyote Insectivore	No
2,4,5-Trichlorophenol	1,100		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
2,4,6-Trichlorophenol	950	25,287	No	**704**	**Yes**	**701**	**Yes**	**695**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
2,4,6-Trinitrotoluene	56	29,530	No	1,172	No	1,184	No	1,227	No	N/A	N/A	Coyote Carnivore	No
2,4-Dimethylphenol	88		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
2-Butanone	155	68,394,223	No	4,119,850	No	4,235,955	No	4,643,176	No	N/A	N/A	Coyote Carnivore	No
2-Hexanone	20		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
2-Methylnaphthalene	12,000	470,625	No	12,267	No	12,189	No	**11,996**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
4,4'-DDD	10	13,214,620	No	66,262	No	64,373	No	59,465	No	N/A	N/A	Coyote Insectivore	No
4,4'-DDE	7.2	78,493	No	2,530	No	2,449	No	2,240	No	N/A	N/A	Coyote Insectivore	No
4,4'-DDT	26	374,883	No	1,873	No	1,808	No	1,644	No	N/A	N/A	Coyote Insectivore	No
4,6-Dinitro-2-methylphenol	390	63,246	No	2,345	No	2,363	No	2,427	No	N/A	N/A	Coyote Carnivore	No
4-Chloro-3-methylphenol	67		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
4-Isopropyltoluene	100		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
4-Methyl-2-pentanone	73	1,204,515	No	58,449	No	59,562	No	63,379	No	N/A	N/A	Coyote Carnivore	No
4-Methylphenol	270		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
4-Nitroaniline	820	3,691,447	No	166,186	No	168,819	No	177,828	No	N/A	N/A	Coyote Carnivore	No
4-Nitrophenol	320	1,447,852	No	58,587	No	59,254	No	61,547	No	N/A	N/A	Coyote Carnivore	No
Acenaphthene	44,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Acenaphthylene	600		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Acetone	1,280	341,202	No	23,175	No	23,963	No	26,778	No	N/A	N/A	Coyote Carnivore	No
Aldrin	17	18,504	No	233	No	225	No	204	No	N/A	N/A	Coyote Insectivore	No
alpha-BHC	7.9	3,690,321	No	84,381	No	83,405	No	80,847	No	N/A	N/A	Coyote Insectivore	No
Anthracene	47,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Benzene	11	1,556,809	No	61,785	No	62,438	No	64,693	No	N/A	N/A	Coyote Carnivore	No
Benzo(a)anthracene	45,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Benzo(a)pyrene	43,000	2,408,022	No	**3,062**	**Yes**	**2,971**	**Yes**	**2,756**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
Benzo(b)fluoranthene	49,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Benzo(g,h,i)perylene	28,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Benzo(k)fluoranthene	25,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Benzoic Acid	1,100		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Benzyl Alcohol	2,800	354,317	No	17,529	No	17,877	No	19,073	No	N/A	N/A	Coyote Carnivore	No
beta-BHC	11	41,004	No	938	No	927	No	898	No	N/A	N/A	Coyote Insectivore	No
beta-Chlordane	2.6	758,988	No	10,725	No	10,398	No	9,553	No	N/A	N/A	Coyote Insectivore	No
bis(2-ethylhexyl)phthalate	75,000	4,931,556	No	**42,305**	**Yes**	**40,167**	**Yes**	**34,967**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**

Table 2.1
Comparison of MDCs in Surface Soil to NOAEL ESLs for Wide-Ranging Receptors

Analyte	MDC	Mule Deer		Coyote Carnivore		Coyote Generalist		Coyote Insectivore		Terrestrial Receptor*		Most Sensitive Receptor	Retain for Further Analysis?
		NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?		
Bromochloromethane	7		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Butylbenzylphthalate	7,100	5,079,629	No	110,121	No	108,616	No	104,645	No	N/A	N/A	Coyote Insectivore	No
Carbazole	700		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Carbon Disulfide	4	583,411	No	23,436	No	23,696	No	24,590	No	N/A	N/A	Coyote Carnivore	No
Carbon Tetrachloride	103	1,054,831	No	37,529	No	37,757	No	38,582	No	N/A	N/A	Coyote Carnivore	No
Chlorobenzene	2.03	595,322	No	20,175	No	20,258	No	20,576	No	N/A	N/A	Coyote Carnivore	No
Chloroform	7	789,511	No	35,115	No	35,654	No	37,496	No	N/A	N/A	Coyote Carnivore	No
Chloromethane	1.7		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Chrysene	46,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
cis-1,2-Dichloroethene	15	188,528	No	7,500	No	7,580	No	7,857	No	N/A	N/A	Coyote Carnivore	No
delta-BHC	23	5,125	No	117	No	116	No	112	No	N/A	N/A	Coyote Insectivore	No
Dibenz(a,h)anthracene	9,200		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Dibenzofuran	20,000	3,590,000	No	93,800	No	93,200	No	91,800	No	N/A	N/A	Coyote Insectivore	No
Dicamba	150	183,802	No	7,034	No	7,097	No	7,320	No	N/A	N/A	Coyote Carnivore	No
Dichloroprop	10		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Dieldrin	92	411	No	**34**	**Yes**	**33**	**Yes**	**32**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
Diesel Range Organics	8.80E+06		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Diethylphthalate	420	318,025,677	No	10,751,695	No	10,794,883	No	10,961,049	No	N/A	N/A	Coyote Carnivore	No
Dimethylphthalate	460	19,065,499	No	819,700	No	831,099	No	870,128	No	N/A	N/A	Coyote Carnivore	No
Di-n-butylphthalate	10,000	61,326,419	No	1,288,317	No	1,269,119	No	1,218,364	No	N/A	N/A	Coyote Insectivore	No
Di-n-octylphthalate	11,000	464,903,263	No	3,853,344	No	3,653,170	No	3,168,532	No	N/A	N/A	Coyote Insectivore	No
Endosulfan I	7.4	12,798	No	352	No	350	No	347	No	N/A	N/A	Coyote Insectivore	No
Endosulfan II	9.9	12,798	No	352	No	350	No	347	No	N/A	N/A	Coyote Insectivore	No
Endosulfan sulfate	24	12,798	No	352	No	350	No	347	No	N/A	N/A	Coyote Insectivore	No
Endrin	17	12,536	No	215	No	210	No	197	No	N/A	N/A	Coyote Insectivore	No
Endrin aldehyde	9.2	12,536	No	215	No	210	No	197	No	N/A	N/A	Coyote Insectivore	No
Endrin ketone	36	12,536	No	215	No	210	No	197	No	N/A	N/A	Coyote Insectivore	No
Ethylbenzene	173		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Fluoranthene	140,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Fluorene	39,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
gamma-BHC (Lindane)	8.3	5,125	No	117	No	116	No	112	No	N/A	N/A	Coyote Insectivore	No
Gasoline	2,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Heptachlor epoxide	23	13,772	No	293	No	289	No	277	No	N/A	N/A	Coyote Insectivore	No
Hexachlorobenzene	380	300,322	No	4,669	No	4,545	No	4,219	No	N/A	N/A	Coyote Insectivore	No
Hexachlorobutadiene	2.2	228,964	No	4,684	No	4,609	No	4,411	No	N/A	N/A	Coyote Insectivore	No
HMX	230	1,196,511	No	63,027	No	64,450	No	69,366	No	N/A	N/A	Coyote Carnivore	No
Indeno(1,2,3-cd)pyrene	32,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Isophorone	850		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Isopropylbenzene	27		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
MCPA	1,100		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Methoxychlor	450	358,904	No	5,840	No	5,695	No	5,313	No	N/A	N/A	Coyote Insectivore	No
Methylene Chloride	45	294,601	No	13,687	No	13,922	No	14,727	No	N/A	N/A	Coyote Carnivore	No
Naphthalene	41,000	55,700,000	No	104,269	No	107,146	No	117,177	No	N/A	N/A	Coyote Carnivore	No
n-Butylbenzene	350		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT

Table 2.1
Comparison of MDCs in Surface Soil to NOAEL ESLs for Wide-Ranging Receptors

Analyte	MDC	Mule Deer		Coyote Carnivore		Coyote Generalist		Coyote Insectivore		Terrestrial Receptor[a]		Most Sensitive Receptor	Retain for Further Analysis?
		NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?		
N-Nitroso-di-n-propylamine	400		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
n-Propylbenzene	190		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Total Dioxins[c]	0.0739	0.19	No	0.0735	**Yes**	0.034	**Yes**	0.015	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
Total PCBs	12,300	61,287	No	**833**	**Yes**	**1,050**	**Yes**	**3,681**	**Yes**	N/A	N/A	Coyote Carnivore	**Yes**
Pentachlorophenol	39,000	**27,940**	**Yes**	**562**	**Yes**	**553**	**Yes**	**528**	**Yes**	N/A	N/A	Coyote Insectivore	**Yes**
Phenanthrene	170,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Phenol	130	2,100,203	No	93,638	No	95,083	No	100,028	No	N/A	N/A	Coyote Carnivore	No
Pyrene	120,000		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
sec-Butylbenzene	42.6		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Styrene	7.8	2,207,112	No	70,388	No	70,505	No	71,080	No	N/A	N/A	Coyote Carnivore	No
tert-Butylbenzene	1.6		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Tetrachloroethene	29,000	105,023	No	**3,285**	**Yes**	**3,288**	**Yes**	**3,307**	**Yes**	N/A	N/A	Coyote Carnivore	**Yes**
Toluene	990	1,756,446	No	60,990	No	61,301	No	62,452	No	N/A	N/A	Coyote Carnivore	No
Trichloroethene	200	46,488	No	1,642	No	1,651	No	1,686	No	N/A	N/A	Coyote Carnivore	No
Trichlorofluoromethane	31.9		N/A		N/A		N/A		N/A	N/A	N/A	N/A	UT
Xylene	933	162,199	No	4,927	No	4,926	No	4,937	No	N/A	N/A	Coyote Generalist	No
Radionuclides (pCi/g)													
Americium-241	51.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,890	No	Terrestrial Receptor	No
Cesium-134	0.150	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Cesium-137	2.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	21	No	Terrestrial Receptor	No
Curium-242	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Curium-244	-0.00290	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Curium-245/246	0.126	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Gross Alpha	320	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Gross Beta	305	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Neptunium-237	0.0187	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Plutonium-238	1.53	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Plutonium-239/240	183	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,110	No	Terrestrial Receptor	No
Radium-226	2.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	51	No	Terrestrial Receptor	No
Radium-228	3.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	44	No	Terrestrial Receptor	No
Strontium-89/90	2.87	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	23	No	Terrestrial Receptor	No
Uranium-233/234	47.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4,980	No	Terrestrial Receptor	No
Uranium-235	2.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,770	No	Terrestrial Receptor	No
Uranium-238	209	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,580	No	Terrestrial Receptor	No

[a]Radionuclide ESLs are not receptor-specific. They are considered protective of all terrestrial ecological species.

[b] ESLs for chromium are based on Chromium VI.

[c]Concentrations for total dioxins are based on the calculated mamalian toxic equivalency factors for the various congeners detected.

N/A = No ESL available for the ECOI/receptor pair.

UT = Uncertain toxicity; no ESL available (assessed in Section 6.0).

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 2.2
Summary of Wide-Ranging Receptor NOAEL ESL Screening Results

Analyte	Terrestrial Vertebrate Exceedance?
Inorganics (mg/kg)	
Aluminum	UT
Ammonia	No
Antimony	**Yes**
Arsenic	**Yes**
Barium	No
Beryllium	No
Boron	No
Cadmium	**Yes**
Calcium	UT
Cesium	UT
Chromium	**Yes**
Chromium VI	No
Cobalt	No
Copper	No
Cyanide	No
Fluoride	No
Iron	UT
Lead	No
Lithium	No
Magnesium	UT
Manganese	No
Mercury	**Yes**
Molybdenum	**Yes**
Nickel	**Yes**
Nitrate / Nitrite	No
Nitrite	UT
Potassium	UT
Selenium	No
Silica	UT
Silicon	UT
Silver	UT
Sodium	UT
Strontium	No
Thallium	No
Tin	**Yes**
Titanium	UT
Uranium	No
Vanadium	**Yes**
Zinc	**Yes**
Organics (µg/kg)	
1,1,1-Trichloroethane	No
1,1,2,2-Tetrachloroethane	No
1,1,2-Trichloro-1,2,2-trifluoroethane	UT
1,1-Dichloroethene	No
1,2,3-Trichlorobenzene	UT

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Table 2.2
Summary of Wide-Ranging Receptor NOAEL ESL Screening Results

Analyte	Terrestrial Vertebrate Exceedance?
1,2,3-Trichloropropane	No
1,2,4-Trichlorobenzene	No
1,2,4-Trimethylbenzene	UT
1,2-Dichloroethene	No
1,2-Dichloropropane	No
1,3,5-Trimethylbenzene	No
1,4-Dichlorobenzene	No
2,4,5-T	No
2,4,5-Trichlorophenol	UT
2,4,6-Trichlorophenol	**Yes**
2,4,6-Trinitrotoluene	No
2,4-Dimethylphenol	UT
2-Butanone	No
2-Hexanone	UT
2-Methylnaphthalene	**Yes**
4,4'-DDD	No
4,4'-DDE	No
4,4'-DDT	No
4,6-Dinitro-2-methylphenol	No
4-Chloro-3-methylphenol	UT
4-Isopropyltoluene	UT
4-Methyl-2-pentanone	No
4-Methylphenol	UT
4-Nitroaniline	No
4-Nitrophenol	No
Acenaphthene	UT
Acenaphthylene	UT
Acetone	No
Aldrin	No
alpha-BHC	No
Anthracene	UT
Benzene	No
Benzo(a)anthracene	UT
Benzo(a)pyrene	**Yes**
Benzo(b)fluoranthene	UT
Benzo(g,h,i)perylene	UT
Benzo(k)fluoranthene	UT
Benzoic Acid	UT
Benzyl Alcohol	No
beta-BHC	No
beta-Chlordane	No
bis(2-ethylhexyl)phthalate	**Yes**
Bromochloromethane	UT
Butylbenzylphthalate	No
Carbazole	UT
Carbon Disulfide	No

Table 2.2

Summary of Wide-Ranging Receptor NOAEL ESL Screening Results

Analyte	Terrestrial Vertebrate Exceedance?
Carbon Tetrachloride	No
Chlorobenzene	No
Chloroform	No
Chloromethane	UT
Chrysene	UT
cis-1,2-Dichloroethene	No
delta-BHC	No
Dibenz(a,h)anthracene	UT
Dibenzofuran	No
Dicamba	No
Dichloroprop	UT
Dieldrin	**Yes**
Diesel Range Organics	UT
Diethylphthalate	No
Dimethylphthalate	No
Di-n-butylphthalate	No
Di-n-octylphthalate	No
Endosulfan I	No
Endosulfan II	No
Endosulfan sulfate	No
Endrin	No
Endrin aldehyde	No
Endrin ketone	No
Ethylbenzene	UT
Fluoranthene	UT
Fluorene	UT
gamma-BHC (Lindane)	No
Gasoline	UT
Heptachlor epoxide	No
Hexachlorobenzene	No
Hexachlorobutadiene	No
HMX	No
Indeno(1,2,3-cd)pyrene	UT
Isophorone	UT
Isopropylbenzene	UT
MCPA	UT
Methoxychlor	No
Methylene Chloride	No
Naphthalene	No
n-Butylbenzene	UT
N-Nitroso-di-n-propylamine	UT
n-Propylbenzene	UT
Total Dioxins	**Yes**
Total PCBs	**Yes**
Pentachlorophenol	**Yes**
Phenanthrene	UT

Table 2.2
Summary of Wide-Ranging Receptor NOAEL ESL Screening Results

Analyte	Terrestrial Vertebrate Exceedance?
Phenol	No
Pyrene	UT
sec-Butylbenzene	UT
Styrene	No
tert-Butylbenzene	UT
Tetrachloroethene	**Yes**
Toluene	No
Trichloroethene	No
Trichlorofluoromethane	UT
Xylene	No
Radionuclides (pCi/g)	
Americium-241	No
Cesium-134	UT
Cesium-137	No
Curium-242	UT
Curium-244	UT
Curium-245/246	UT
Gross Alpha	UT
Gross Beta	UT
Neptunium-237	UT
Plutonium-238	UT
Plutonium-239/240	No
Radium-226	No
Radium-228	No
Strontium-89/90	No
Uranium-233/234	No
Uranium-235	No
Uranium-238	No

UT = Uncertain toxicity; no ESL available (assessed in Section 6.0).
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 2.3
Statistical Distributions and Comparison to Background for Sitewide Surface Soil

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			Sitewide			Test	1 - p	Retain as ECOI?
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Inorganics (mg/kg)									
Antimony	20	NONPARAMETRIC	0	2,482	NONPARAMETRIC	20	N/A	N/A	**Yes**[a]
Arsenic	20	NORMAL	100	2,613	NONPARAMETRIC	99	WRS	0.998	No
Cadmium	20	NONPARAMETRIC	65	2,603	NONPARAMETRIC	36	WRS	1.000	No
Chromium	20	NORMAL	100	2,624	NONPARAMETRIC	99	WRS	0.030	**Yes**
Mercury	20	NONPARAMETRIC	40	2,541	NONPARAMETRIC	49	WRS	1.000	No
Molybdenum	20	NORMAL	0	2,421	NONPARAMETRIC	47	N/A	N/A	**Yes**[a]
Nickel	20	NORMAL	100	2,620	NONPARAMETRIC	97	WRS	0.077	**Yes**
Tin	20	NORMAL	0	2,423	NONPARAMETRIC	10	N/A	N/A	**Yes**[a]
Vanadium	20	NORMAL	100	2,622	NONPARAMETRIC	100	WRS	0.434	No
Zinc	20	NORMAL	100	2,622	NONPARAMETRIC	100	WRS	0.583	No

[a] Statistical comparisons to background cannot be performed. The analyte is retained as an ECOI for further evaluation.

-- = Screen not performed because ECOI was eliminated from further consideration by a previous step.

N/A = Not applicable. Background comparison was not performed because background data were not available or detection frequency of an analyte in EU or

Table 2.4
Statistical Concentrations in Surface Soil

Analyte	Number of Samples	Mean	Median	75th Percentile	95th Percentile	95UCL	95UTL	MDC
Inorganics (mg/kg)								
Antimony	2,482	2.25	0.645	2.20	6.70	3.24	6.00	348
Chromium	2,624	15.4	12.9	17.0	30.0	16.5	24.0	210
Molybdenum	2,421	0.984	0.700	1.20	2.50	1.08	2.25	19.1
Nickel	2,620	12.3	11.0	14.8	22.0	13.2	19.3	280
Tin	2,423	3.44	1.10	1.75	12.8	4.47	9.90	161
Organics (µg/kg)								
2-Methylnaphthalene	1,223	264	190	350	400	282	380	12,000
Benzo(a)pyrene	1,235	392	195	360	1,200	552	800	43,000
bis(2-ethylhexyl)phthalate	1,227	401	190	353	494	683	400	75,000
2,3,7,8-TCDD TEQ (Mammal)[a]	22	0.008	0.004	0.008	0.018	0.016	0.074	0.074
Total PCBs	845	359	170	200	1,536	581	605	12,300
Tetrachloroethene	633	49.6	0.728	2.50	6.00	336	5.50	29,000

[a]Concentrations for total dioxins are based on the calculated mamalian toxic equivalency factors for the various congeners detected.
MDC = Maximum detected concentration or in some cases, maximum proxy result.
UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then MDC is used as the UCL.
UTL = 95% upper confidence limit on the 90th percentile value, unless the MDC< UTL than the MDC is used as the UTL.

Table 2.5

Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Wide-Ranging Receptors

Analyte	Large Home Range Receptor 95th UCL	Receptor-Specific ESLs[a]			
		Mule Deer	Coyote (carnivore)	Coyote (generalist)	Coyote (insectivore)
Inorganics (mg/kg)					
Antimony	3.24	58	138	13	3.9
Chromium	16.5	1,461	4,173	250	69
Molybdenum	1.08	44	275	29	8.2
Nickel	13.2	124	91	**6.0**	**1.9**
Tin	4.47	242	70	36	16
Organics (µg/kg)					
2-Methylnaphthalene	282	685,000	17,800	17,700	17,500
Benzo(a)pyrene	552	14,300,000	15,500	15,000	13,800
bis(2-ethylhexyl)phthalate	683	4,931,556	42,305	40,167	34,967
2,3,7,8-TCDD TEQ (Mammal)	0.016	0.19	0.074	0.034	**0.015**
Total PCBs	581	86,000	1,180	1,500	4,620
Tetrachloroethene	336	105,023	3,285	3,288	3,307

[a]Theshold ESL (if avaiable)

If tESL was not available, then the NOAEL ESL was used.

N/A = not applicable; ESL not available.

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 2.6

Summary of ECOPC Screening Steps for Surface Soil - Wide-Ranging Receptors

Analyte	Exceeds Any NOAEL ESL?	Detection Frequency >5%?	Exceeds Background[a]?	Upper Bound EPC > Limiting ESL	Professional Judgment - Retain?	ECOPC?	Receptor(s) of Potential Concern
Inorganics							
Aluminum	UT	--	--	--	--	No	--
Ammonia	No	--	--	--	--	No	--
Antimony	**Yes**	**Yes**	**N/A**	No	--	No	--
Arsenic	**Yes**	--	--	--	--	No	--
Barium	No	--	--	--	--	No	--
Beryllium	No	--	--	--	--	No	--
Boron	No	--	--	--	--	No	--
Cadmium	**Yes**	**Yes**	No	--	--	No	--
Calcium	UT	--	--	--	--	No	--
Cesium	UT	--	--	--	--	No	--
Chromium	**Yes**	**Yes**	**Yes**	No	--	No	--
Chromium VI	No	--	--	--	--	No	--
Cobalt	No	--	--	--	--	No	--
Copper	No	--	--	--	--	No	--
Cyanide	No	--	--	--	--	No	--
Fluoride	No	--	--	--	--	No	--
Iron	UT	--	--	--	--	No	--
Lead	No	--	--	--	--	No	--
Lithium	No	--	--	--	--	No	--
Magnesium	UT	--	--	--	--	No	--
Manganese	No	--	--	--	--	No	--
Mercury	**Yes**	**Yes**	No	--	--	No	--
Molybdenum	**Yes**	**Yes**	**N/A**	No	--	No	--
Nickel	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Coyote Generalist Coyote Insectivore**
Nitrate / Nitrite	No	--	--	--	--	No	--
Nitrite	UT	--	--	--	--	No	--
Potassium	UT	--	--	--	--	No	--
Selenium	No	--	--	--	--	No	--
Silica	UT	--	--	--	--	No	--
Silicon	UT	--	--	--	--	No	--
Silver	UT	--	--	--	--	No	--
Sodium	UT	--	--	--	--	No	--
Strontium	No	--	--	--	--	No	--
Thallium	No	--	--	--	--	No	--
Tin	**Yes**	**Yes**	**N/A**	No	--	No	--
Titanium	UT	--	--	--	--	No	--
Uranium	No	--	--	--	--	No	--
Vanadium	**Yes**	**Yes**	No	--	--	No	--
Zinc	**Yes**	**Yes**	No	--	--	No	--
Organics							
1,1,1-Trichloroethane	No	--	--	--	--	No	--
1,1,2,2-Tetrachloroethane	No	--	--	--	--	No	--
1,1,2-Trichloro-1,2,2-trifluoroethane	UT	--	--	--	--	No	--
1,1-Dichloroethene	No	--	--	--	--	No	--
1,2,3-Trichlorobenzene	UT	--	--	--	--	No	--
1,2,3-Trichloropropane	No	--	--	--	--	No	--
1,2,4-Trichlorobenzene	No	--	--	--	--	No	--
1,2,4-Trimethylbenzene	UT	--	--	--	--	No	--
1,2-Dichloroethene	No	--	--	--	--	No	--
1,2-Dichloropropane	No	--	--	--	--	No	--
1,3,5-Trimethylbenzene	No	--	--	--	--	No	--
1,4-Dichlorobenzene	No	--	--	--	--	No	--
2,4,5-T	No	--	--	--	--	No	--
2,4,5-Trichlorophenol	UT	--	--	--	--	No	--
2,4,6-Trichlorophenol	**Yes**	No	--	--	--	No	--
2,4,6-Trinitrotoluene	No	--	--	--	--	No	--

Table 2.6

Summary of ECOPC Screening Steps for Surface Soil - Wide-Ranging Receptors

Analyte	Exceeds Any NOAEL ESL?	Detection Frequency >5%?	Exceeds Background?	Upper Bound EPC > Limiting ESL	Professional Judgment - Retain?	ECOPC?	Receptor(s) of Potential Concern
Inorganics							
2,4-Dimethylphenol	UT	--	--	--	--	No	--
2-Butanone	No	--	--	--	--	No	--
2-Hexanone	UT	--	--	--	--	No	--
2-Methylnaphthalene	**Yes**	**Yes**	N/A	No	--	No	--
2-Methylphenol	No	--	--	--	--	No	--
4,4'-DDD	No	--	--	--	--	No	--
4,4'-DDE	No	--	--	--	--	No	--
4,4'-DDT	No	--	--	--	--	No	--
4,6-Dinitro-2-methylphenol	No	--	--	--	--	No	--
4-Chloro-3-methylphenol	UT	--	--	--	--	No	--
4-Isopropyltoluene	UT	--	--	--	--	No	--
4-Methyl-2-pentanone	No	--	--	--	--	No	--
4-Methylphenol	UT	--	--	--	--	No	--
4-Nitroaniline	No	--	--	--	--	No	--
4-Nitrophenol	No	--	--	--	--	No	--
Acenaphthene	UT	--	--	--	--	No	--
Acenaphthylene	UT	--	--	--	--	No	--
Acetone	No	--	--	--	--	No	--
Aldrin	No	--	--	--	--	No	--
alpha-BHC	No	--	--	--	--	No	--
Anthracene	UT	--	--	--	--	No	--
Benzene	No	--	--	--	--	No	--
Benzo(a)anthracene	UT	--	--	--	--	No	--
Benzo(a)pyrene	**Yes**	**Yes**	N/A	No	--	No	--
Benzo(b)fluoranthene	UT	--	--	--	--	No	--
Benzo(g,h,i)perylene	UT	--	--	--	--	No	--
Benzo(k)fluoranthene	UT	--	--	--	--	No	--
Benzoic Acid	UT	--	--	--	--	No	--
Benzyl Alcohol	No	--	--	--	--	No	--
beta-BHC	No	--	--	--	--	No	--
beta-Chlordane	No	--	--	--	--	No	--
bis(2-ethylhexyl)phthalate	**Yes**	**Yes**	N/A	No	--	No	--
Bromochloromethane	UT	--	--	--	--	No	--
Butylbenzylphthalate	No	--	--	--	--	No	--
Carbazole	UT	--	--	--	--	No	--
Carbon Disulfide	No	--	--	--	--	No	--
Carbon Tetrachloride	No	--	--	--	--	No	--
Chlorobenzene	No	--	--	--	--	No	--
Chloroform	No	--	--	--	--	No	--
Chloromethane	UT	--	--	--	--	No	--
Chrysene	UT	--	--	--	--	No	--
cis-1,2-Dichloroethene	No	--	--	--	--	No	--
delta-BHC	No	--	--	--	--	No	--
Dibenz(a,h)anthracene	UT	--	--	--	--	No	--
Dibenzofuran	No	--	--	--	--	No	--
Dicamba	No	--	--	--	--	No	--
Dichloroprop	UT	--	--	--	--	No	--
Dieldrin	**Yes**	No	--	--	--	No	--
Diesel Range Organics	UT	--	--	--	--	No	--
Diethylphthalate	No	--	--	--	--	No	--
Dimethylphthalate	No	--	--	--	--	No	--
Di-n-butylphthalate	No	--	--	--	--	No	--
Di-n-octylphthalate	No	--	--	--	--	No	--
Endosulfan I	No	--	--	--	--	No	--
Endosulfan II	No	--	--	--	--	No	--
Endosulfan sulfate	No	--	--	--	--	No	--
Endrin	No	--	--	--	--	No	--

Table 2.6

Summary of ECOPC Screening Steps for Surface Soil - Wide-Ranging Receptors

Analyte	Exceeds Any NOAEL ESL?	Detection Frequency >5%?	Exceeds Background*?	Upper Bound EPC > Limiting ESL	Professional Judgment Retain?	ECOPC?	Receptor(s) of Potential Concern
Inorganics							
Endrin aldehyde	No	--	--	--	--	No	--
Endrin ketone	No	--	--	--	--	No	--
Ethylbenzene	UT	--	--	--	--	No	--
Fluoranthene	UT	--	--	--	--	No	--
Fluorene	UT	--	--	--	--	No	--
gamma-BHC (Lindane)	No	--	--	--	--	No	--
Gasoline	UT	--	--	--	--	No	--
Heptachlor epoxide	No	--	--	--	--	No	--
Hexachlorobenzene	No	--	--	--	--	No	--
Hexachlorobutadiene	No	--	--	--	--	No	--
HMX	No	--	--	--	--	No	--
Indeno(1,2,3-cd)pyrene	UT	--	--	--	--	No	--
Isophorone	UT	--	--	--	--	No	--
Isopropylbenzene	UT	--	--	--	--	No	--
MCPA	UT	--	--	--	--	No	--
Methoxychlor	No	--	--	--	--	No	--
Methylene Chloride	No	--	--	--	--	No	--
Naphthalene	No	--	--	--	--	No	--
n-Butylbenzene	UT	--	--	--	--	No	--
N-Nitroso-di-n-propylamine	UT	--	--	--	--	No	--
n-Propylbenzene	UT	--	--	--	--	No	--
Total Dioxins	**Yes**	**Yes**	N/A	**Yes**	**Yes**	**Yes**	**Coyote Insectivore**
Total PCBs	**Yes**	**Yes**	N/A	No	--	No	--
Pentachlorophenol	**Yes**	No	--	--	--	No	--
Phenanthrene	UT	--	--	--	--	No	--
Phenol	No	--	--	--	--	No	--
Pyrene	UT	--	--	--	--	No	--
sec-Butylbenzene	UT	--	--	--	--	No	--
Styrene	No	--	--	--	--	No	--
tert-Butylbenzene	UT	--	--	--	--	No	--
Tetrachloroethene	**Yes**	**Yes**	N/A	No	--	No	--
Toluene	No	--	--	--	--	No	--
Total Petroleum Hydrocarbons	UT	--	--	--	--	No	--
Trichloroethene	No	--	--	--	--	No	--
Trichlorofluoromethane	UT	--	--	--	--	No	--
Xylene	No	--	--	--	--	No	--
Radionuclides							
Americium-241	No	--	--	--	--	No	--
Cesium-134	UT	--	--	--	--	No	--
Cesium-137	No	--	--	--	--	No	--
Curium-242	UT	--	--	--	--	No	--
Curium-244	UT	--	--	--	--	No	--
Curium-245/246	UT	--	--	--	--	No	--
Gross Alpha	UT	--	--	--	--	No	--
Gross Beta	UT	--	--	--	--	No	--
Neptunium-237	UT	--	--	--	--	No	--
Plutonium-238	UT	--	--	--	--	No	--
Plutonium-239/240	No	--	--	--	--	No	--
Radium-226	No	--	--	--	--	No	--
Radium-228	No	--	--	--	--	No	--
Strontium-89/90	No	--	--	--	--	No	--
Uranium-233/234	No	--	--	--	--	No	--
Uranium-235	No	--	--	--	--	No	--
Uranium-238	No	--	--	--	--	No	--

* Based on results of statistical analysis at the 0.1 level of significance.

-- = Screen not preformed because ECOI was eliminated from further consideration in a previous step.

N/A - Not applicable; ESL not available or background comparison could not be conducted.

Table 2.6

Summary of ECOPC Screening Steps for Surface Soil - Wide-Ranging Receptors

Analyte	Exceeds Any NOAEL ESL?	Detection Frequency >5%?	Exceeds Background?	Upper Bound EPC > Limiting ESL	Professional Judgment Retain?	ECOPC?	Receptor(s) of Potential Concern
Inorganics							

Bold = Analyte retained as an ECOPC for risk characterization.

Table 3.1
Summary of ECOPC/Receptor Pairs

ECOPC	Receptors of Potential Concern
Surface Soil	
Nickel	Coyote (generalist) Coyote (insectivore)
2,3,7,8-TCDD TEQ (Mammal)	Coyote (insectivore)

Table 3.2
Surface Soil Exposure Point Concentrations for Wide-Ranging Receptors

ECOPC	Tier I Exposure Point Concentrations (mg/kg)		Tier II Exposure Point Concentrations (mg/kg)	
	95th UTL	95th UCL	95th UTL	95th UCL
Inorganics				
Nickel	19.3	13.2	13.0	12.6
Organics				
2,3,7,8-TCDD TEQ (Mammal)[a]	7.39E-05	1.63E-05	1.13E-05	8.40E-06

[a]Concentrations for total dioxins are based on the calculated mamalian toxic equivalency factors for the various congeners detected.

Table 3.3
Surface Water Exposure Point Concentrations for Wide-Ranging Receptors

ECOPC	Units	MDC	95th UTL	95th UCL	Mean
Inorganics					
Nickel	mg/L	0.479	0.015	0.009	0.008
Organics					
2,3,7,8-TCDD TEQ (Mammal)	mg/L	N/A			

N/A = Data were not available.

NC = Not calculated. MDC used as a surrogate.

Table 3.4
Receptor-Specific Exposure Parameters

Receptor	Body Weight (kg)	Body Weight Reference	Percentage of Diet				Food Ingestion Rate (kg/kg BW day^{-1})	Ingestion Rate Reference	Water Ingestion Rate (L/kg BW day^{-1})	Ingestion Rate Reference	Percentage of Diet as Soil	Soil Ingestion Reference
			Plant Tissue	Invertebrate Tissue	Bird or Mammal Tissue	Dietary Reference						
Mammals												
Coyote (generalist)	12.75	Bekoff (1977) - Average of male and female weights	0	25	75	Generalized Diet	0.015	Gier (1975)	0.08	EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983)	5	Beyer et al. (1994) - High end estimate for Red Fox
Coyote (insectivore)	12.75	Bekoff (1977) - Average of male and female weights	0	100	0	Generalized Diet	0.015	Gier (1975)	0.08	EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983)	2.8	Beyer et al. (1994) - Red Fox

Receptor parameters for all receptors were taken from the Watershed Risk Assessment (DOE 1996) and referenced to the original source.

All receptor parameters are estimates of central tendency except where noted.

All values are presented in a dry weight basis.

Table 3.5
Receptor Specific Intake Estimates

	Intake Estimates (mg/kg BW day)					
	Plant Tissue	Invertebrate Tissue	Mammal Tissue	Soil	Surface Water	Total
Default Exposure Estimates						
Nickel						
Coyote - Generalist						
Tier 1 95th UCL	N/A	2.34E-01	2.92E-02	9.89E-03	7.20E-04	2.74E-01
Tier 2 95th UCL	N/A	2.24E-01	2.87E-02	9.48E-03	7.20E-04	2.63E-01
Coyote - Insectivore						
Tier 1 95th UCL	N/A	9.36E-01	N/A	5.54E-03	7.20E-04	9.42E-01
Tier 2 95th UCL	N/A	8.97E-01	N/A	5.31E-03	7.20E-04	9.03E-01
2,3,7,8-TCDD TEQ (Mammal)						
Coyote - Insectivore						
Tier 1 95th UCL	N/A	9.18E-07	N/A	6.83E-09	0.00E+00	9.25E-07
Tier 2 95th UCL	N/A	4.15E-07	N/A	3.53E-09	0.00E+00	4.19E-07

N/A = Not applicable.

Table 4.1
Toxicity Reference Values for Wide-Ranging Receptors

ECOPC	NOAEL (mg/kg day)	NOAEL Endpoint	Lowest Bounded LOAEL (mg/kg day)	LOAEL Endpoint	TRV Source	Uncertainty Factor	Final NOAEL (mg/kg day)	Threshold (mg/kg day)	TRV Confidence
Sitewide Receptors - Mammals									
Nickel	0.133	NOAEL was estimated from LOAEL	1.33	Increase in pup mortality in rats	PRC (1994)	1	0.133	N/A	High
2,3,7,8-TCDD TEQ (Mammal)	0.000001	No reproductive effects in rats.	0.000001	No reproductive effects in rats.	Sample et al. (1996)	1	0.00001	N/A	High

Threshold TRVs were independently calculated using the procedures outline in the CRA Methodology.

TRV Confidence:

NA = No TRV has been identified or the TRV has been deemed unacceptable for use in ECOPC selection.

Low = TRVs that have data for only one species looking at one endpoint (non-mortality) and from one primary literature source.

Moderate = TRVs that have multiple primary literature sources looking at one endpoint (non-mortality or mortality) but with only one species evaluated.

Good = For TRVs that have either multiple species with one endpoint from multiple studies or those TRVs with multiple species and multiple endpoints from only one stud

High = For TRVs that have multiple study sources looking at multiple endpoints and more than one species.

Very High = All EcoSSLs (EPA 2003) will be assigned this level of confidence by default.

Table 5.1
Hazard Quotient Summary For Wide-Ranging Receptors

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs)	
				Based on Default TRVs	Based on Alternate TRVs (Uncertainty Analysis)
Nickel	Coyote (generalist)	Default	Tier 1	*NOAEL* UCL = 2 *LOAEL* UCL = 0.2	Not Calculated
			Tier 2	*NOAEL* UCL = 2 *LOAEL* UCL = 0.2	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Coyote (insectivore)	Default	Tier 1	*NOAEL* UCL = 7 *LOAEL* UCL = 0.7	Not Calculated
			Tier 2	*NOAEL* UCL = 7 *LOAEL* UCL = 0.7	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
2,3,7,8-TCDD TEQ (Mammal)	Coyote (insectivore)	Default	Tier 1	*NOAEL* UCL = 0.9 *LOAEL* UCL = 0.09	Not Calculated
			Tier 2	*NOAEL* UCL = 0.4 *LOAEL* UCL = 0.04	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated

Shaded cells represent default HQ calculations based on exposure and toxicity models specifically identified in the CRA Methodology
All HQ Calculations are provided in Attachment 4.
Discussion of the chemical-specific uncertainties are provided in Attachment 5.

Table 5.2
Tier 2 Grid Cell Hazard Quotients for Sitewide Surface Soil

ECOPC	Most Sensitive Receptor	Number of Grid Cells	Percent of Tier 2 Grid Means							
			NOAEL TRV				LOAEL TRV			
			HQ < 1	HQ > 1 <5	HQ > 5 <10	HQ > 10	HQ < 1	HQ > 1 <5	HQ > 5 <10	HQ > 10
Nickel	Coyote - Insectivore	201	0	16	77	7	93	7	0	0
2,3,7,8-TCDD TEQ (Mammal)	Coyote - Insectivore	4	100	0	0	0	100	0	0	0

N/A = No value available
The limiting receptor is chosen as the receptor with the lowest ESL.

Table 6.1
Summary of Risk Characterization Results for Wide-Ranging Receptors in RFETS

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Surface Soil - Sitewide Receptors			
Nickel	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	NOAEL HQs > 1 for default exposure and TRVs using Tier 1 and Tier 2 UCLs. LOAEL HQs < 1 for default exposure and TRVs using Tier 1 and Tier 2 UCLs.	Low Risk
	Coyote (insectivore)	NOAEL HQs > 1 for default exposure and TRVs using Tier 1 and Tier 2 UCLs. LOAEL HQs < 1 for default exposure and TRVs using Tier 1 and Tier 2 UCLs.	Low Risk
	Mule Deer	Not an ECOPC.	Not an ECOPC
2,3,7,8-TCDD TEQ (Mammal)	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	NOAEL HQs < 1 for default exposure and TRVs using Tier 1 and Tier 2 UCLs. LOAEL HQs < 1 for default exposure and TRVs using Tier 1 and Tier 2 UCLs.	Low Risk
	Mule Deer	Not an ECOPC.	Not an ECOPC

FIGURES

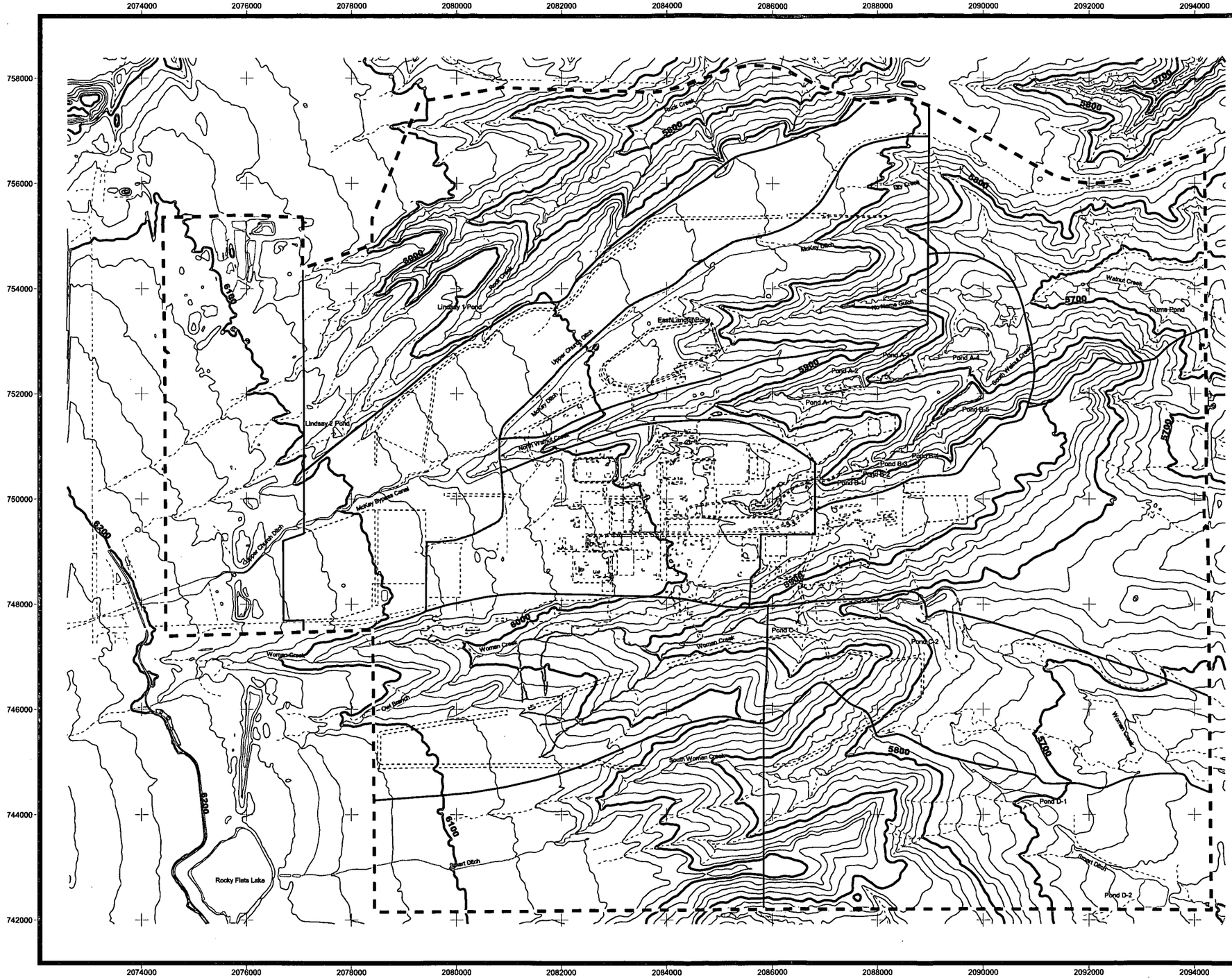

Figure 1.1

Sitewide Topography and Historical IHSS Locations

KEY

- Historical IHSS/PAC
- Topographic contour interval = 100 ft.
- Topographic contour interval = 20 ft.

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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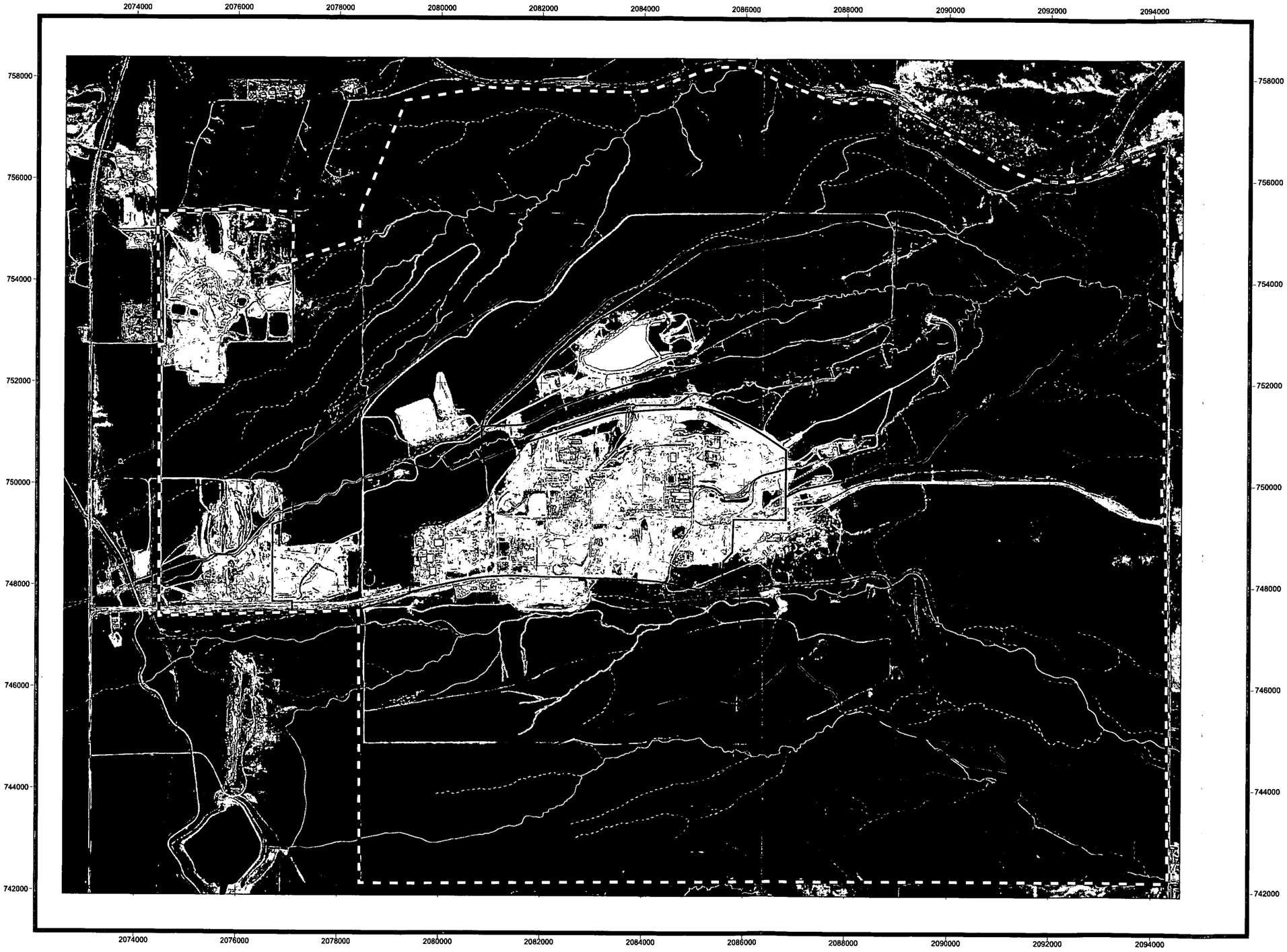

Figure 1.2

Sitewide Aerial Photograph
July 2005

Standard Map Features

- Exposure unit boundary
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1000 2000 Feet

Scale 1:24000

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Colorado Central Zone
Datum: NAD 27

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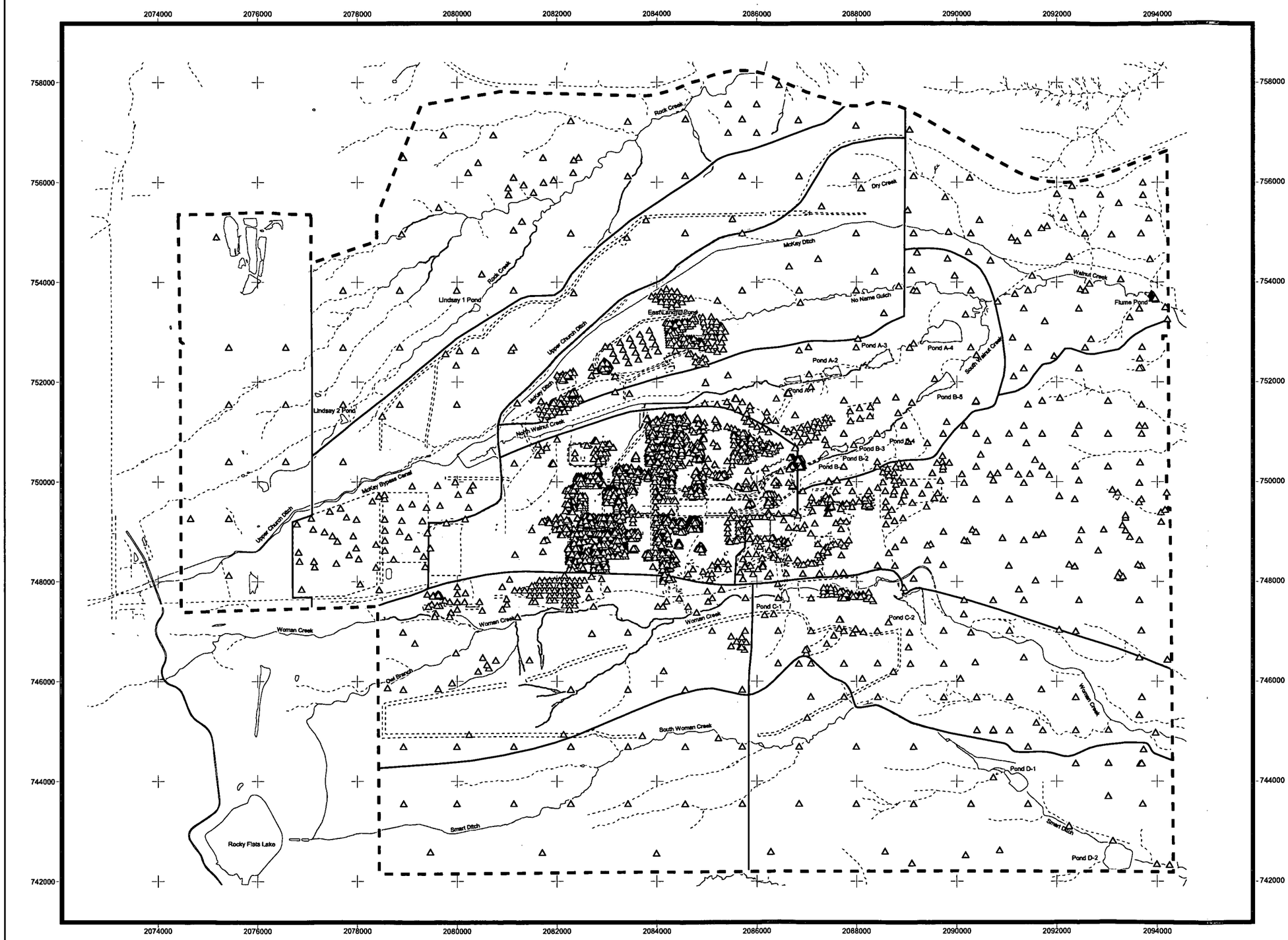
Figure 1.3

Sitewide Surface Soil Sample Locations



KEY

- Surface soil sample location
- Historical IHSS/PAC

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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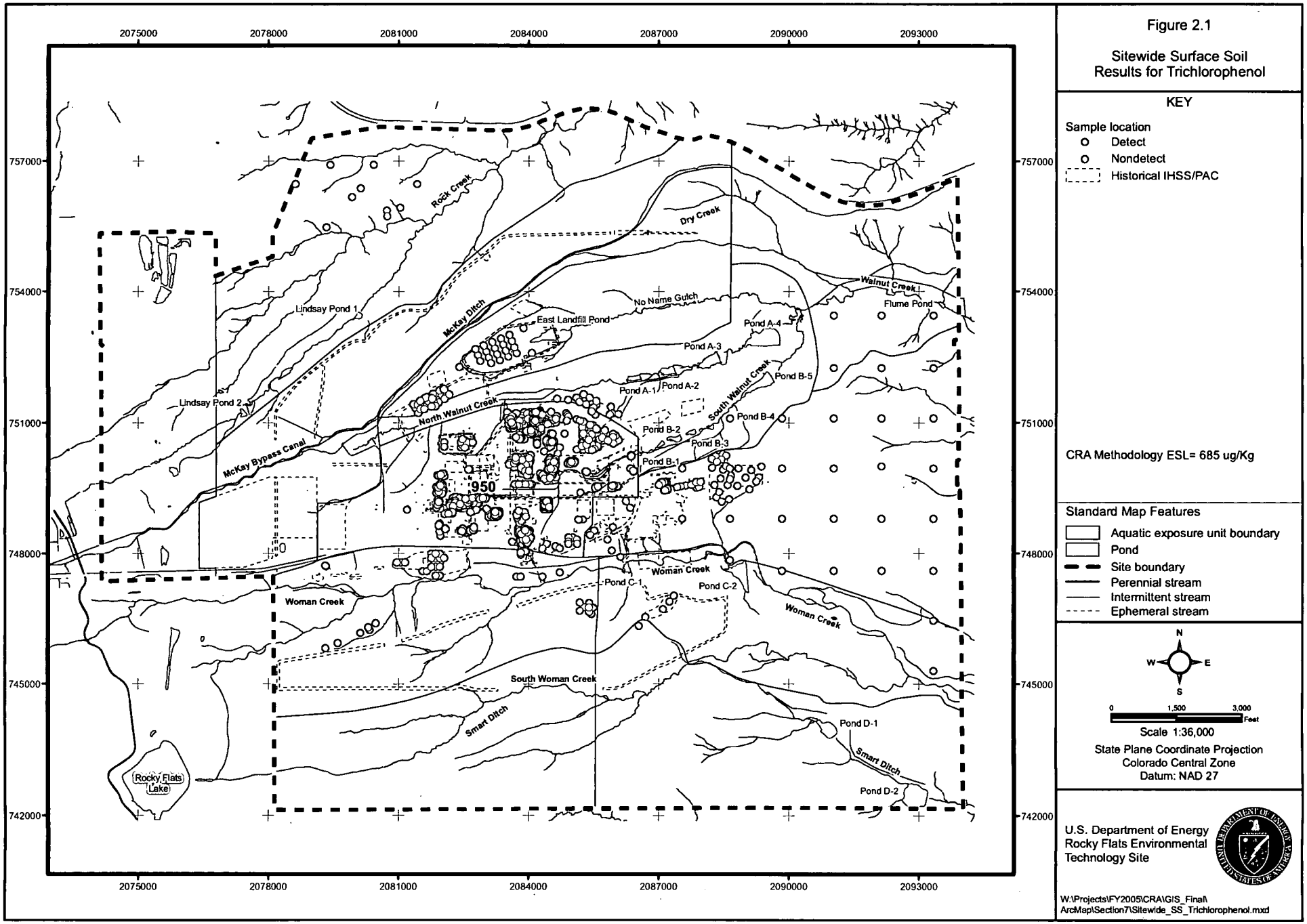

Figure 2.1

Sitewide Surface Soil Results for Trichlorophenol

KEY

Sample location
- Detect
- Nondetect
- Historical IHSS/PAC

CRA Methodology ESL= 685 ug/Kg

Standard Map Features
- Aquatic exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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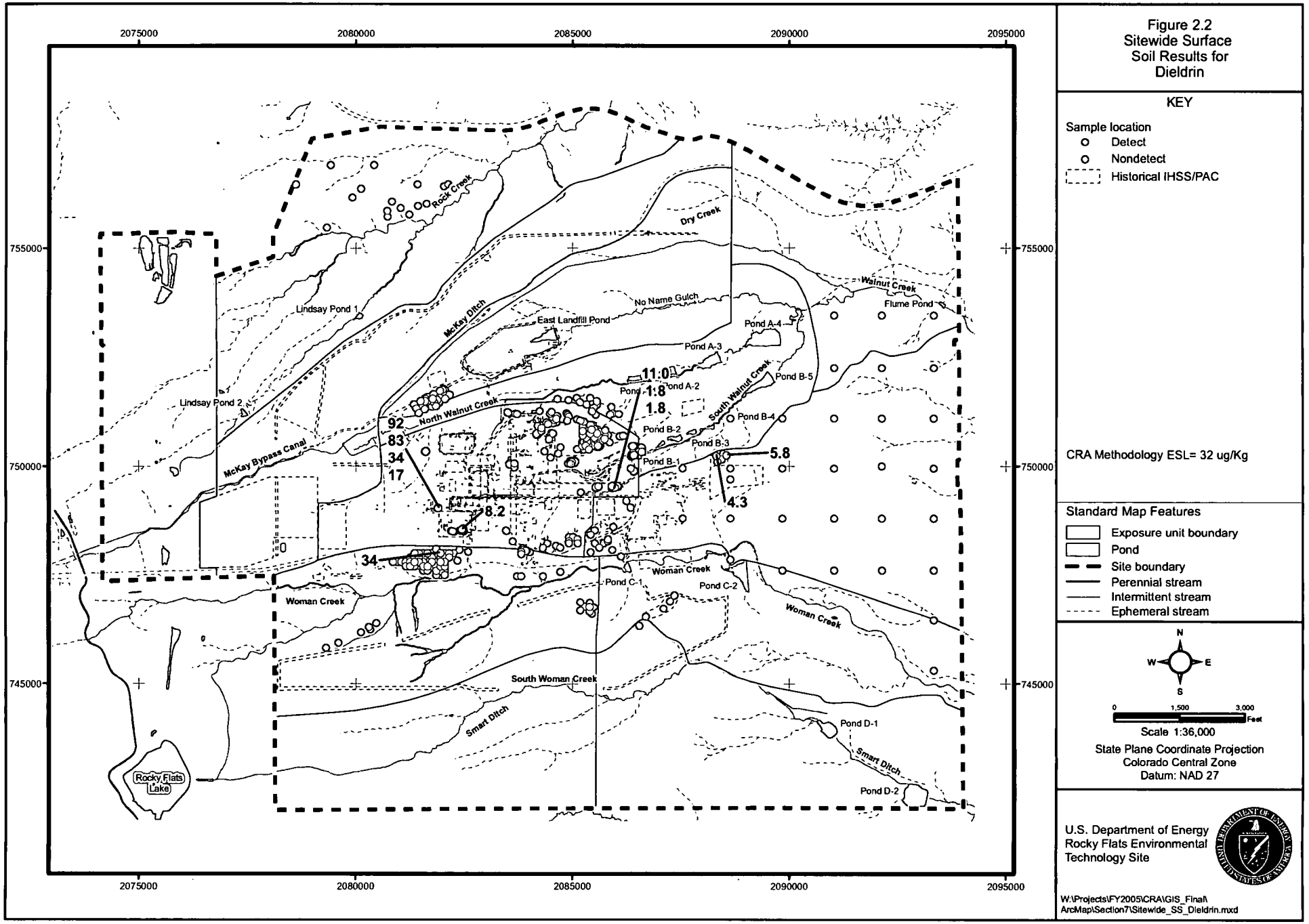

Figure 2.2
Sitewide Surface Soil Results for Dieldrin

KEY

Sample location
- Detect
- Nondetect
- Historical IHSS/PAC

CRA Methodology ESL= 32 ug/Kg

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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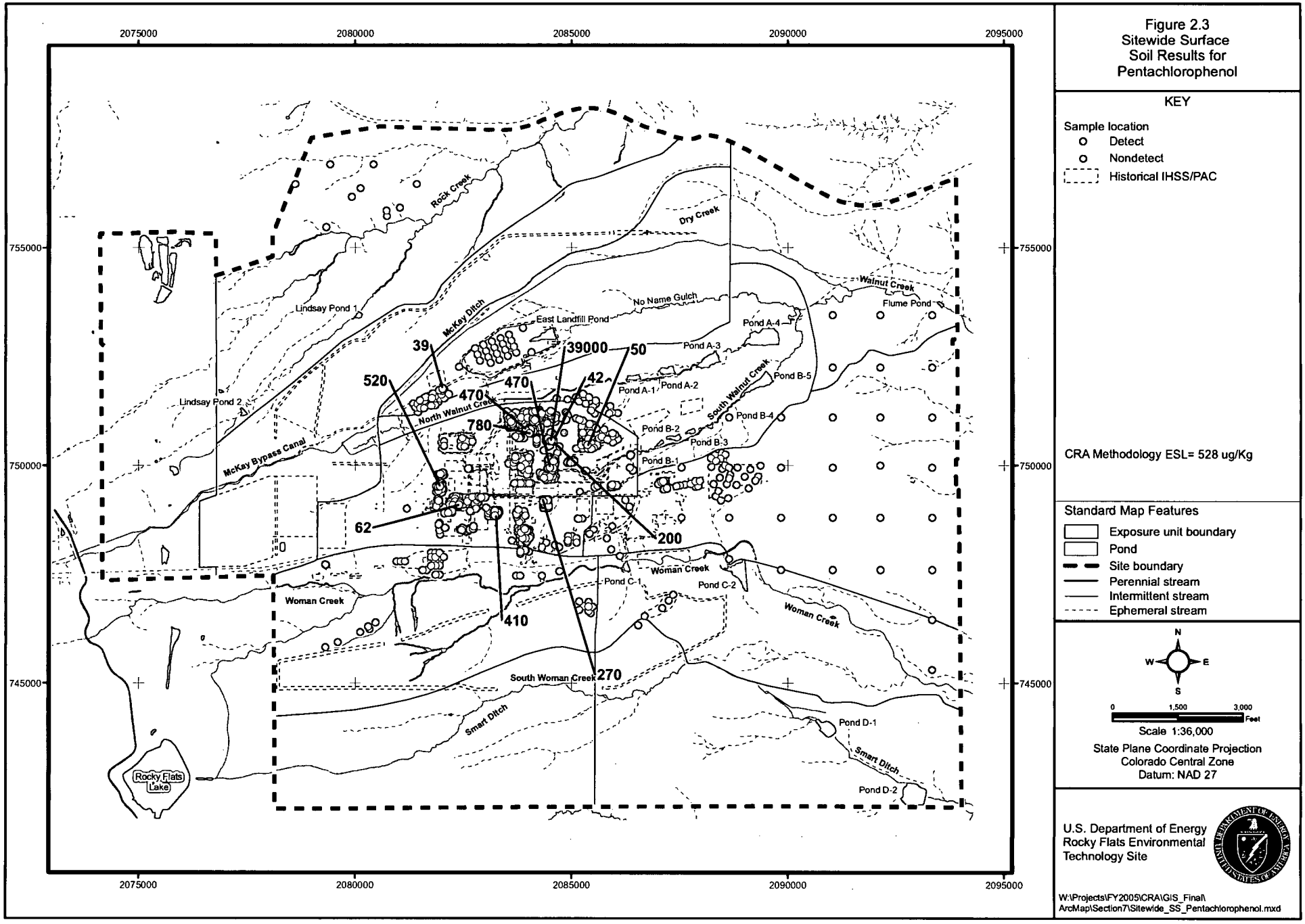

Figure 2.3
Sitewide Surface Soil Results for Pentachlorophenol

KEY

Sample location
- Detect
- Nondetect
- Historical IHSS/PAC

CRA Methodology ESL= 528 ug/Kg

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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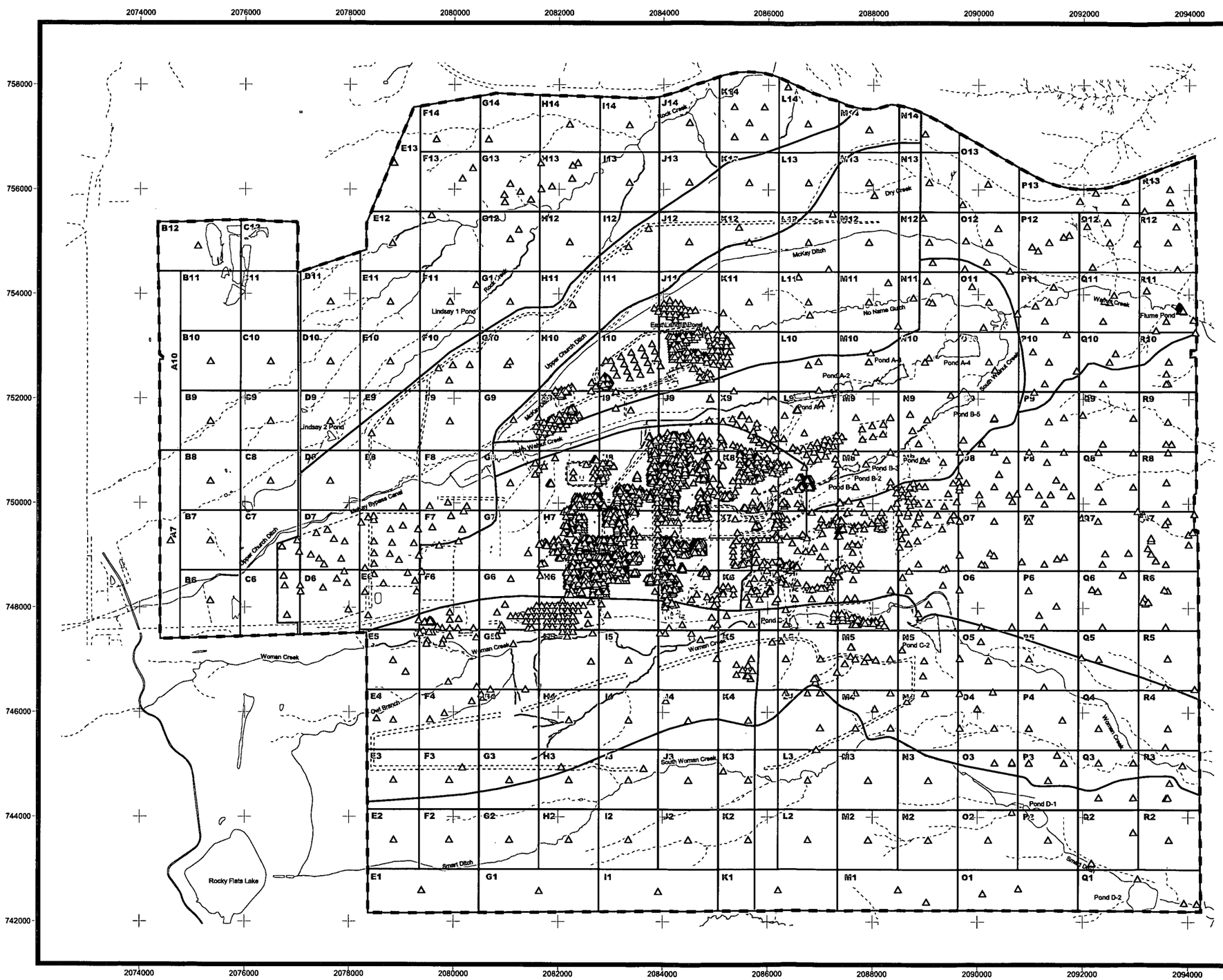


Figure 3.1

Sitewide Tier 2 EPC 30-Acre Grids with Surface Soil Sample Locations

KEY

- Surface soil sample location
- 30-acre grid
- A1 Grid cell ID

Standard Map Features

- Exposure unit boundary
- Historical IHSS/PAC
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1000 2000 Feet

Scale 1:24000

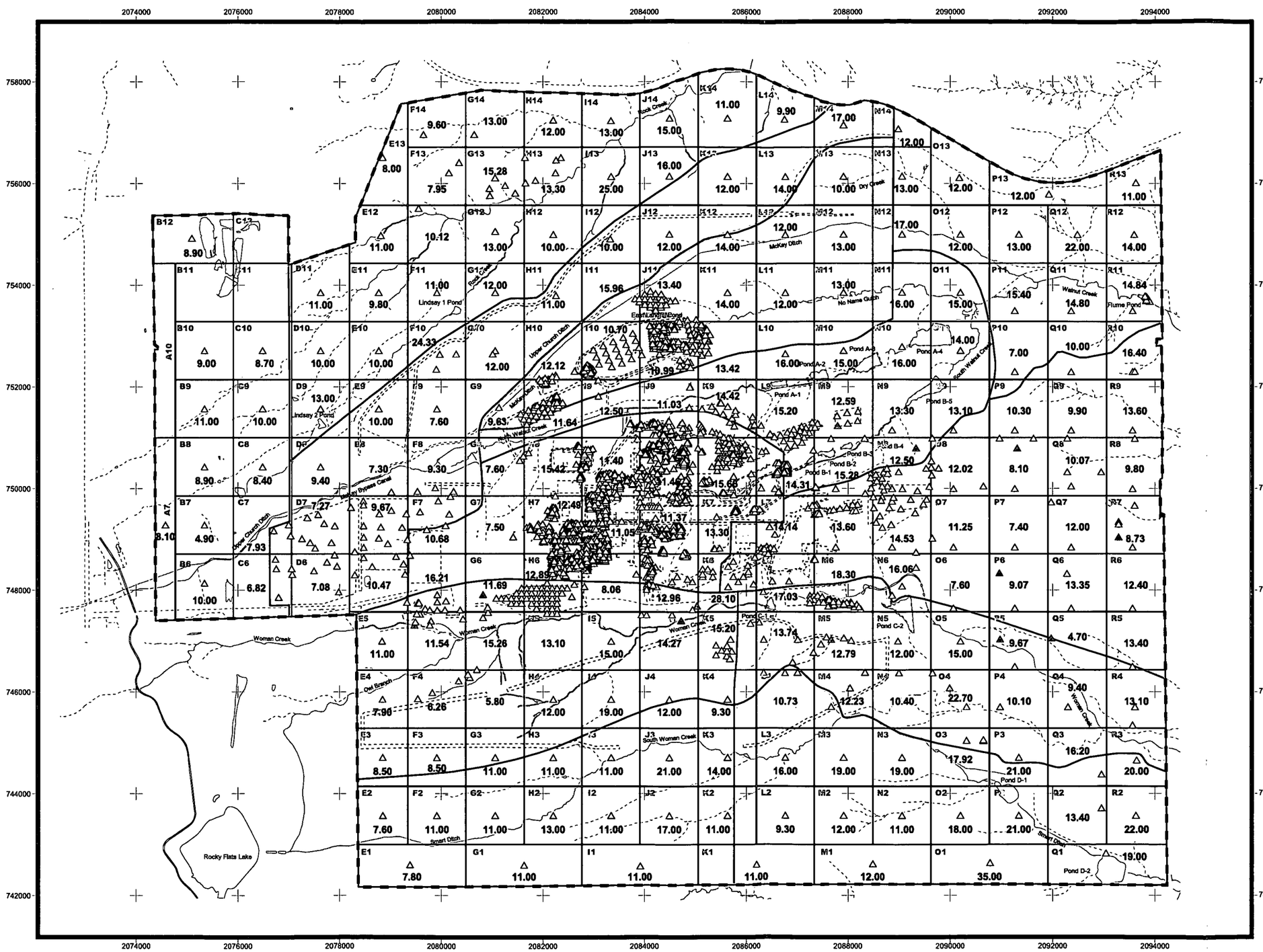
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Sitewide_Eco\Sitewide_Eco_Sect_3.apr

Figure 5.1

Sitewide Surface Soil Sample-by-Sample Comparison to the Limiting ESLs for Large Home Range Receptors - Nickel



KEY

Surface soil sample location

- △ Detect >= 10 x ESL
- △ Detect >= ESL < 10 x ESL
- △ Detect < ESL
- △ Nondetect
- 30-acre grid
- A1 Grid cell ID

ESL: 1.86 mg/kg
Receptor: Coyote (Insectivore)
95th UCL background: 10.6 mg/kg
Maximum background concentration: 14 mg/kg

Standard Map Features

- Exposure unit boundary
- Historical IHSS/PAC
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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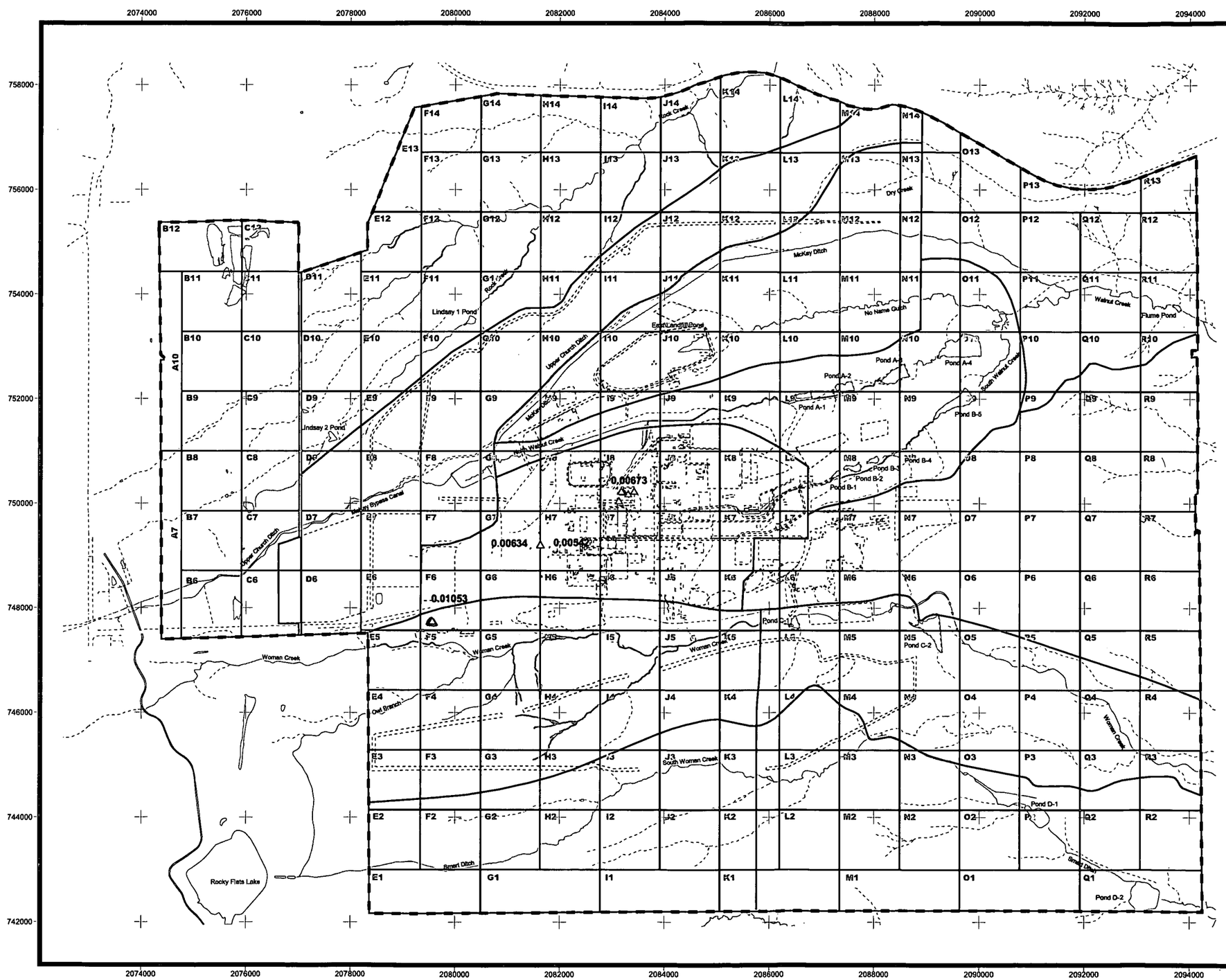
Figure 5.2

Sitewide Surface Soil Sample-by-Sample Comparison to the Limiting ESLs for Large Home Range Receptors - Total Dioxins



KEY

Surface soil sample location

- △ Detect >= 10 x ESL
- △ Detect >= ESL < 10 x ESL
- △ Detect < ESL
- 30-acre grid
- A1 Grid cell ID

ESL: 0.015 ug/kg
Receptor: Coyote (Insectivore)
95th UCL background: N/A
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Historical IHSS/PAC
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Sitewide_Eco\Sitewide_Eco_Sect_5.apr

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COMPREHENSIVE RISK ASSESSMENT

WIDE-RANGING ECOLOGICAL RECEPTORS

VOLUME 15A: ATTACHMENT 1

Detection Limit Screen

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ERA	ecological risk assessment
ESL	ecological screening level

1.0 EVALUATION OF DETECTION LIMITS FOR NONDETECTED ANALYTES AND ANALYTES DETECTED IN LESS THAN 5 PERCENT OF SAMPLES IN THE NO NAME GULCH DRAINAGE EXPOSURE UNIT

The detection limits for analytes that are either not detected or detected in less than 5 percent of the samples collected in surface soil for the Ecological Risk Assessment (ERA) are reviewed in this attachment. The detection limits are compared to the minimum ecological screening level (ESL) for a variety of ecological receptors. The results of these comparisons are presented in Tables A1.1. Maximum reported results that exceed the respective ESLs are noted and discussed. The detection limits reported in this attachment are at the lowest level at which the chemical may be accurately and reproducibly quantified, taking into account the sample characteristics, sample collection, sample preparation, and analytical adjustments.

The maximum reported results for 14 nondetected analytes and 29 analytes detected in less than 5 percent of samples in surface soil are greater than the ESL (Table A1.1). However, the minimum reported value for only 9 of these analytes exceed the ESL. Of these 9 analytes, the minimum reported result is in the range of 2 to 8 times the ESL, except for hexachlorobenzene which is approximately 40 times the ESL. Because detection limits for most of the nondetected analytes and analytes detected in less than 5 percent of samples are less than the ESLs, the uncertainty associated with detection limits is acceptable.

ESLs are not available for several nondetected organic analytes and organic analytes detected in less than 5 percent of samples in surface soil (Table A1.1). Because ESLs are available for most of these analytes in surface soil, and the maximum reported results for these analytes are much lower than the ESLs, the lack of ESLs for less than half of the organics is unlikely to have a significant effect on the results of the risk assessment.

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TABLES

Table A1.1

Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less Than 5 Percent in Surface Soil

Analyte	Range of Reported Results			Total Number of Results	Lowest BSL 2	Maximum Result < BSL 2
Organics (ug/kg)						
1,1,1,2-Tetrachloroethane	0.502	-	131	517	N/A	N/A
1,1,1-Trichloroethane[b]	0.587	-	680	623	551,453	No
1,1,2,2-Tetrachloroethane[b]	0.527	-	680	631	60,701	No
1,1,2-Trichloro-1,2,2-trifluoroethane[b]	0.587	-	109	516	N/A	N/A
1,1,2-Trichloroethane	0.502	-	680	633	N/A	N/A
1,1-Dichloroethane	0.512	-	680	633	3,121	No
1,1-Dichloroethene[b]	0.61	-	680	632	16,909	No
1,1-Dichloropropene	0.424	-	79.4	517	N/A	N/A
1,2,3-Trichlorobenzene[b]	0.641	-	97.8	511	N/A	N/A
1,2,3-Trichloropropane[b]	0.525	-	129	516	13,883	No
1,2,4-Trichlorobenzene[b]	**0.621**	**-**	**7,000**	**1,544**	**777**	**Yes**
1,2-Dibromo-3-chloropropane	1.368	-	589	516	N/A	N/A
1,2-Dibromoethane	0.502	-	138	517	N/A	N/A
1,2-Dichlorobenzene	0.502	-	6,900	1,329	N/A	N/A
1,2-Dichloroethane	0.522	-	680	629	2,764	No
1,2-Dichloroethene[b]	5	-	680	100	25,617	No
1,2-Dichloropropane[b]	0.413	-	680	631	49,910	No
1,3,5-Trinitrobenzene	250	-	250	5	N/A	N/A
1,3-Dichlorobenzene	0.505	-	7,000	1,549	N/A	N/A
1,3-Dichloropropane	0.492	-	85.5	517	N/A	N/A
1,3-Dinitrobenzene	250	-	250	5	N/A	N/A
1,4-Dichlorobenzene[b]	0.649	-	6,900	1,320	20,000	No
2,2-Dichloropropane	0.466	-	114	517	N/A	N/A
2,4,5-TP (Silvex)	14.8	-	100	11	N/A	N/A
2,4,5-Trichlorophenol[b]	**330**	**-**	**34,000**	**1,179**	**4,000**	**Yes**
2,4,6-Trichlorophenol[b]	**330**	**-**	**7,000**	**1,179**	**161**	**Yes**
2,4-D	83	-	100	11	N/A	N/A
2,4-DB	83	-	100	9	426	No
2,4-Dichlorophenol	**330**	**-**	**7,000**	**1,180**	**2,744**	**Yes**
2,4-Dimethylphenol[b]	330	-	7,000	1,177	N/A	N/A
2,4-Dinitrophenol	**850**	**-**	**35,000**	**1,173**	**20,000**	**Yes**
2,4-Dinitrotoluene	**250**	**-**	**7,000**	**1,232**	**32.1**	**Yes**
2,6-Dinitrotoluene	**250**	**-**	**7,000**	**1,232**	**6,186**	**Yes**
2-Amino-4,6-dinitrotoluene	250	-	250	5	N/A	N/A
2-Butanone[b]	2.72	-	1,400	615	1.07E+06	No
2-Chloroethyl vinyl ether	10	-	11	15	N/A	N/A
2-Chloronaphthalene	330	-	7,000	1,227	N/A	N/A
2-Chlorophenol	**330**	**-**	**7,000**	**1,180**	**281**	**Yes**
2-Chlorotoluene	0.475	-	118	515	N/A	N/A
2-Hexanone[b]	1.54	-	1,400	625	N/A	N/A
2-Methylphenol	330	-	7,000	1,180	123,842	No

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Table A1.1

Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less Than 5 Percent in Surface Soil

Analyte	Range of Reported Results			Total Number of Results	Lowest ESL	Maximum Result > ESL?
2-Nitroaniline	**370**	**-**	**35,000**	**1,224**	**5,659**	**Yes**
2-Nitrophenol	330	-	7,000	1,180	N/A	N/A
2-Nitrotoluene	250	-	250	5	N/A	N/A
3,3'-Dichlorobenzidine	340	-	23,000	1,190	N/A	N/A
3-Nitroaniline	850	-	55,000	1,193	N/A	N/A
3-Nitrotoluene	250	-	250	5	N/A	N/A
4,4'-DDD[b]	1.8	-	190	466	13,726	No
4,4'-DDE[b]	**1.8**	**-**	**190**	**461**	**7.95**	**Yes**
4,4'-DDT[b]	**1.8**	**-**	**190**	**464**	**1.20**	**Yes**
4,6-Dinitro-2-methylphenol[b]	**850**		**35,000**	**1,175**	**560**	**Yes**
4-Amino-2,6-dinitrotoluene	250		250	5	N/A	N/A
4-Bromophenyl-phenylether	330		7,000	1,227	N/A	N/A
4-Chloro-3-methylphenol[b]	330		14,000	1,177	N/A	N/A
4-Chloroaniline	**330**		**14,000**	**1,217**	**716**	**Yes**
4-Chlorophenyl-phenyl ether	330		7,000	1,227	N/A	N/A
4-Chlorotoluene	0.622		96.9	515	N/A	N/A
4-Isopropyltoluene[b]	0.431		70.2	500	N/A	N/A
4-Methyl-2-pentanone[b]	1.94		2,960	615	14,630	No
4-Methylphenol[b]	330		7,000	1,175	N/A	N/A
4-Nitroaniline[b]	**850**		**55,000**	**1,214**	**41,050**	**Yes**
4-Nitrophenol[b]	**850**		**35,000**	**1,167**	**7,000**	**Yes**
4-Nitrotoluene	250		250	5	61,422	No
Acenaphthylene[b]	330		6,900	1,236	N/A	N/A
Aldrin[b]	**1.8**		**95**	**464**	**47.0**	**Yes**
alpha-BHC[b]	1.8		95	467	18,662	No
alpha-Chlordane	**1.8**		**950**	**433**	**289**	**Yes**
Azinphos-methyl	86		890	7	N/A	N/A
Benzene[b]	**0.502**		**680**	**627**	**500**	**Yes**
Benzyl Alcohol[b]	**330**		**14,000**	**1,106**	**4,403**	**Yes**
beta-BHC[b]	1.8		95	465	207	No
beta-Chlordane[b]	**1.8**		**950**	**410**	**289**	**Yes**
bis(2-Chloroethoxy) methane	330		7,000	1,227	N/A	N/A
bis(2-Chloroethyl) ether	330		7,000	1,222	N/A	N/A
bis(2-Chloroisopropyl) ether	330		11,000	1,207	N/A	N/A
Bromobenzene	0.502		121	515	N/A	N/A
Bromochloromethane[b]	0.502		106	516	N/A	N/A
Bromodichloromethane	0.502		680	633	5,750	No
Bromoform	0.525		680	633	2,855	No
Bromomethane	0.972		221	629	N/A	N/A
Carbon Disulfide[b]	0.535		680	632	5,676	No

Table A1.1

Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less Than 5 Percent in Surface Soil

Analyte	Range of Reported Results			Total Number of Results	Lowest ESL	Maximum Result > ESL?
Carbon Tetrachloride[b]	0.575		680	612	8,906	No
Chlordane	18		220	34	289	No
Chlorobenzene[b]	0.484		680	631	4,750	No
Chloroethane	0.862		1,400	630	N/A	N/A
Chloroform[b]	0.543		680	626	8,655	No
Chloromethane[b]	0.992		1,400	630	N/A	N/A
Chlorpyriphos	8.6		89	7	N/A	N/A
cis-1,2-Dichloroethene[b]	0.502		590	508	1,814	No
cis-1,3-Dichloropropene	0.502		680	633	2,800	No
Coumaphos	18		180	7	N/A	N/A
Cyanide[b]	0.18		4.70	239	607	No
Dalapon	42		100	9	N/A	N/A
delta-BHC[b]	**1.8**		**95**	**467**	**25.9**	**Yes**
Demeton	8.6		89	7	N/A	N/A
Diazinon	8.6		89	7	N/A	N/A
Dibromochloromethane	0.502		680	633	5,730	No
Dibromomethane	0.502		141	517	N/A	N/A
Dichlorodifluoromethane	1.73		398	499	855	No
Dichlorovos	18		180	7	N/A	N/A
Dieldrin[b]	**1.8**		**190**	**457**	**7.40**	**Yes**
Diesel fuel	25000		29,000	28	N/A	N/A
Diethylphthalate[b]	330		7,000	1,216	100,000	No
Dimethoate	**18**		**180**	**7**	**13.7**	**Yes**
Dimethylphthalate[b]	330		7,000	1,209	200,000	No
Di-n-octylphthalate[b]	330		7,000	1,177	731,367	No
Dinose[b]	12		100	9	N/A	N/A
Disulfoton	8.6		89	7	N/A	N/A
Endosulfan I[b]	**1.8**		**95**	**466**	**80.1**	**Yes**
Endosulfan II[b]	**1.8**		**170**	**458**	**80.1**	**Yes**
Endosulfan sulfate[b]	**1.8**		**190**	**465**	**80.1**	**Yes**
Endrin[b]	**1.8**		**200**	**462**	**1.40**	**Yes**
Endrin aldehyde[b]	**1.8**		**38**	**64**	**1.40**	**Yes**
Endrin ketone[b]	**1.8**		**190**	**436**	**1.40**	**Yes**
Ethoprop	8.6		89	7	N/A	N/A
Famphur	34		350	7	N/A	N/A
Fensulfothion	31		320	7	N/A	N/A
Fenthion	8.6		89	7	N/A	N/A
gamma-BHC (Lindane)[b]	**1.8**		**95**	**467**	**25.9**	**Yes**
gamma-Chlordane	2		260	23	289	No
Heptachlor	**1.8**		**95**	**468**	**63.3**	**Yes**

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Table A1.1
Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less Than 5 Percent in Surface Soil

Analyte	Range of Reported Results			Total Number of Results	Lowest ESL	Maximum Result > ESL?
Heptachlor epoxide[b]	**1.8**		**95**	**464**	**64.0**	**Yes**
Hexachlorobenzene[b]	**330**		**7,000**	**1,220**	**7.73**	**Yes**
Hexachlorobutadiene[b]	**0.508**		**7,000**	**1,549**	**431**	**Yes**
Hexachlorocyclopentadiene	**330**		**7,000**	**1,208**	**5,518**	**Yes**
Hexachloroethane	**330**		**7,000**	**1,227**	**366**	**Yes**
Isophorone[b]	330		7,000	1,221	N/A	N/A
Isopropylbenzene[b]	0.361		94.4	505	N/A	N/A
Malathion	21		210	7	N/A	N/A
MCPP	8300		100,000	9	N/A	N/A
Merphos	8.6		89	7	N/A	N/A
Methoxychlor[b]	3.5		950	460	1,226	No
Methyl parathion	8.6		89	7	N/A	N/A
Mevinphos	31		320	7	N/A	N/A
Naled	260		2,700	7	N/A	N/A
n-Butylbenzene[b]	0.471		93.9	508	N/A	N/A
Nitrobenzene	250		7,000	1,218	40,000	No
Nitroglycerin	5000		5,000	5	N/A	N/A
N-Nitroso-di-n-propylamine[b]	330		7,000	1,221	N/A	N/A
N-nitrosodiphenylamine	330		7,000	1,227	20,000	No
n-Propylbenzene[b]	0.537		89.5	503	N/A	N/A
O,O,O-Triethyl phosphorothioate	8.6		89	7	N/A	N/A
Parathion	8.6		89	7	N/A	N/A
PCB-1016[b]	**33**		**4,500**	**789**	**172**	**Yes**
PCB-1221	**33**		**4,500**	**845**	**172**	**Yes**
PCB-1232	**33**		**4,500**	**845**	**172**	**Yes**
PCB-1242[b]	**33**		**4,500**	**843**	**172**	**Yes**
PCB-1248[b]	**33**		**4,500**	**839**	**172**	**Yes**
Pentachlorophenol[b]	**850**		**35,000**	**1,168**	**122**	**Yes**
PETN	4000		4,000	5	N/A	N/A
Phenol[b]	330		7,000	1,175	23,090	No
Phorate	8.6		89	7	N/A	N/A
Prothiophos	8.6		89	7	N/A	N/A
Pyridine	660		7,000	377	N/A	N/A
RDX	250		250	5	N/A	N/A
Ronnel	8.6		89	7	N/A	N/A
sec-Butylbenzene[b]	0.549		93	510	N/A	N/A
Styrene[b]	0.55		680	632	16,408	No
Sulprofos	18		180	7	N/A	N/A
Tantalum	13.6		19.9	11	N/A	N/A
tert-Butylbenzene[b]	0.702		92.1	514	N/A	N/A
Tetrachlorvinphos	8.6		89	7	N/A	N/A

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Table A1.1

Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less Than 5 Percent in Surface Soil

Analyte	Range of Reported Results			Total Number of Results	Lowest ESL	Maximum Result[a] > ESL?
Tetraethyl dithiopyrophosphate	8.6		89	7	N/A	N/A
Tetryl	500		500	5	N/A	N/A
Thionazine	8.6		89	7	N/A	N/A
Toxaphene	86		2,200	468	3,756	No
trans-1,2-Dichloroethene	0.738		93.3	532	25,617	No
trans-1,3-Dichloropropene	0.502		680	633	2,800	No
Tributyl phosphate	350		350	1	N/A	N/A
Trichloroethene[b]	**0.5**		**680**	**607**	**389**	**Yes**
Trichloronate	8.6		89	7	N/A	N/A
Vinyl acetate	10		1,400	78	13,986	No
Vinyl Chloride	**0.748**		**1,400**	**633**	**97.7**	**Yes**

[a] Value is the maximum reported result for nondetected analytes.

[b] Analyte has a detection frequency of less than 5 percent.

N/A = Not Applicable

Bold entries indicated maximum result > lowest ESL.

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COMPREHENSIVE RISK ASSESSMENT

WIDE-RANGING ECOLOGICAL RECEPTORS

VOLUME 15A: ATTACHMENT 2

Data Quality Assessment

The risk assessment for wide-ranging ecological receptors evaluates the risk to coyotes and mule deer at the Rocky Flats Environmental Technology Site (RFETS). This risk assessment is based on Exposure Point concentrations (EPCs) for Ecological Contaminants of Potential concern (ECOPC) that were calculated from surface soil data aggregated across the entire RFETS site. Because the data used in the risk assessment for sitewide receptors is for all exposure units (EUs) at RFETS, and EU-specific data quality assessment, as is provided in this attachment for the other risk assessment volumes, is not required. Rather, a sitewide data adequacy assessment was performed to determine whether the available data set is adequate for this risk assessment. The data adequacy assessment rules are presented in the CRA Methodology, and the detailed data adequacy assessment for the data used in this risk assessment, and for the entire CRA, is presented in Appendix A, Volume 2 of the RI/FS Report. The assessment concludes that the data are adequate to estimate risks to ecological receptors and, where data uncertainties exist, risk management decisions can still be rendered.

COMPREHENSIVE RISK ASSESSMENT

WIDE-RANGING ECOLOGICAL RECEPTORS

VOLUME 15A: ATTACHMENT 3

Statistical Analyses and Professional Judgment

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13.

ACRONYMS AND ABBREVIATIONS

COC	contaminant of concern
CRA	Comprehensive Risk Assessment
DQA	Data Quality Assessment
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESL	ecological screening level
EU	Exposure Unit
HRR	Historical Release Report
IA	Industrial Area
IHSS	Individual Hazardous Substance Site
MDC	maximum detected concentration
mg/kg	milligrams per kilogram
NFA	No Further Action
NOAEL	no observed adverse effect level
OU	Operable Unit
PAC	Potential Area of Concern
PCB	polychlorinated biphenyl
PMJM	Preble's meadow jumping mouse
PRG	preliminary remediation goal
RFETS	Rocky Flats Environmental Technology Site

RI/FS	Remedial Investigation/Feasibility Study
SWEEU	Sitewide ERA Exposure Unit
tESL	threshold ESL
UBC	Under Building Contamination
UCL	upper confidence limit
UTL	upper tolerance limit
WRS	Wilcoxon Rank Sum

1.0 INTRODUCTION

This attachment presents the results for the statistical analyses and professional judgment evaluation used to select ecological contaminants of potential concern (ECOPCs) as part of the risk assessment for wide-ranging ecological receptors at the Rocky Flats Environmental Technology Site (RFETS). The methods used to perform the statistical analysis and to develop the professional judgment sections are described in Appendix A, Volume 2, Section 2 of the RI/FS report.

2.0 RESULTS OF STATISTICAL COMPARISONS TO BACKGROUND FOR THE INDUSTRIAL AREA EXPOSURE UNIT

The results of the statistical background comparisons for inorganics and radionuclide ecological contaminants of interest (ECOIs) in sitewide surface soil samples collected for the Sitewide ERA are presented in this section. Box plots are provided for analytes that were carried forward into the statistical comparison step and are presented in Figures A3.2.1 to A3.2.6.[1] The box plots display several reference points: 1) the line inside the box is the median; 2) the lower edge of the box is the 25th percentile; 3) the upper edge of the box is the 75th percentile; 4) the upper lines (called whiskers) are drawn to the greatest value that is less than or equal to 1.5 times the inter-quartile range (the interquartile range is between the 75th and 25th percentiles); 5) the lower whiskers are drawn to the lowest value that is greater than or equal to 1.5 times the inter-quartile range; and 6) solid circles are data points greater or less than the whiskers.

ECOIs for surface soil with concentrations in the Sitewide ERA that are statistically greater than background (or those where background comparisons were not performed) are carried through to the exposure point concentration (EPC) – minimum threshold ecological screening level (tESL) comparison step of the ECOPC selection processes.

ECOIs with concentrations that are not statistically greater than background are not identified as ECOPCs and are not evaluated further.

2.1 Surface Soil Data Used in the ERA

For the ECOIs in surface soil, the MDCs for antimony, arsenic, cadmium, chromium, mercury, molybdenum, nickel, tin, vanadium, and zinc exceeded an ecological screening level (ESL), and these ECOIs were carried forward into the statistical background comparison step. The MDCs for 2,4,6-trichlorophenol, 2-methylnaphthalene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, dieldrin, total dioxins, total PCBs, pentachlorophenol, and tetrachloroethene also exceeded an ESL. 2,4,6-trichlorophenol, dieldrin and pentachlorophenol have less than 5 percent detects and were eliminated from further consideration. The results of the statistical comparison of the surface soil data to

[1] Statistical background comparisons are not performed for analytes if: (1) the background concentrations are non-detections; (2) background data are unavailable; (3) the analyte has low detection frequency in the Sitewide ERA or background data set (< 20 percent); or (4) the analyte is an organic compound. Box plots are not provided for these analytes. However, these analytes are carried forward into the professional judgment evaluation.

background data are presented in Table A3.2.1 and the summary statistics for background and sitewide surface soil data are shown in Table A3.2.2.

The results of the statistical comparisons of the sitewide surface soil to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Chromium
- Nickel

Not Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Cadmium
- Mercury
- Vanadium
- Zinc

Background Comparison not Performed[/]

- Antimony
- Molybdenum
- Tin

3.0 UPPER-BOUND EXPOSURE POINT CONCENTRATION COMPARISON TO LIMITING ECOLOGICAL SCREENING LEVELS

ECOIs in surface soil with concentrations that are statistically greater than background, or background comparisons were not performed, are evaluated further by comparing the EPCs to the limiting tESLs. The EPCs are the upper confidence limits (UCLs) for large home-range receptors, or the MDC in the event that the UCL is greater than the MDC.

3.1 ECOIs in Surface Soil

Antimony, chromium, molybdenum and tin concentrations, along with five organics (2-methylnaphthalene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, total PCBs and tetrachloroethene), were eliminated from further consideration because the EPCs are not greater than the tESLs. Conversely, nickel and total dioxins have EPCs greater than the tESLs and are evaluated further in the professional judgment step.

4.0 PROFESSIONAL JUDGMENT

This section presents the results of the professional judgment step of the ECOPC selection processes for the ERA. Based on the weight of evidence evaluated in the professional judgment step, ECOIs are either included for further evaluation as ECOPCs in the risk characterization step, or excluded from further evaluation.

The professional judgment evaluation takes into account the following lines of evidence: process knowledge, spatial trends, pattern recognition[2], comparison to RFETS background and regional background datasets (see Table A3.4.1 for a summary of regional background data)[3], and risk potential. For ECOIs where the process knowledge and/or spatial trends indicate that the presence of the analyte in the EU may be a result of historical site-related activities, the professional judgment discussion includes only two of the lines of evidence listed above, and it is concluded that these analytes are ECOPCs and are carried forward into risk characterization. For the other ECOIs that are evaluated in the professional judgment step, each of the lines of evidence listed above are included in the discussion.

For metals, Appendix A, Volume 2, Attachment 8, of the RI/FS report provides the details of the process knowledge and spatial trend evaluations. The conclusions from these evaluations are noted in this attachment.

The following ECOIs are evaluated further in the professional judgment step for Sitewide ERA:

- Nickel
- 2,3,7,8-TCDD (TEQ) (mammal)

The following sections provide the professional judgment evaluations, by analyte and by medium for the ECOIs listed above.

4.1 Nickel

Nickel has an EPC in surface soil greater than the limiting tESL, and therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if nickel should be retained for risk characterization are summarized below.

4.1.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS report, process knowledge indicates a potential for nickel to have been released into RFETS soil because

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[2] The pattern recognition evaluation includes the use of probability plots. If two or more distinct populations are evident in the probability plot, this suggests that one or more local releases may have occurred. Conversely, if only one distinct low-concentration population is defined, likely representing a background population, a local release may or may not have occurred. Similar to all statistical methods, the probability plot has limitations in cases where there is inadequate sampling and the magnitude of the release is relatively small. Thus, absence of two clear populations in the probability plots is consistent with, but not definitive proof of, the hypothesis that no releases have occurred. However, if a release has occurred within the sampled area and has been included in the samples, then the elemental concentrations associated with that release are either within the background concentration range or the entire sampled population represents a release, a highly unlikely probability.

[3] The regional background data set for Colorado and the bordering states was extracted from data for the western United States (Shacklette and Boerngen 1984), and is composed of data from Colorado as well as Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming. Although the Colorado and bordering states background data set is not specific to Colorado's Front Range, it is useful for the professional judgment evaluation in the absence of a robust data set for the Front Range. Colorado's Front Range has highly variable terrain that changes elevation over short distances. Consequently, numerous soil types and geologic materials are present at RFETS, and the data set for Colorado and bordering states may be more representative of these variable soil types.

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of the moderate nickel metal inventory and presence of nickel in waste generated during former operations. Therefore nickel may be present in surface soil as a result of historical site-related activities.

4.1.2 Evaluation of Spatial Trends

Surface Soil

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS report, the spatial trend analysis indicates that nickel concentrations in surface soils have concentrations greater than three times the background MDC at locations within or near historical IHSSs.

4.1.3 Conclusion

Nickel was used at RFETS and identified in wastes, and has elevated concentrations (greater than 3 times background) within or near historical IHSSs. Therefore, nickel is being carried forward into the ecological risk characterization.

4.2 2,3,7,8-TCDD (TEQ) (Mammal)

2,3,7,8-TCDD (TEQ) (mammal) has an EPC in surface soil greater than the tESL, and therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if 2,3,7,8-TCDD (TEQ) (mammal) should be retained for risk characterization are summarized below.

4.2.1 Summary of Process Knowledge

The Building 121 Security Incinerator (PAC 100-609) is an IHSS at RFETS where no carbon required (NCR)-paper containing PCBs was burned and may have resulted in the formation of dioxins. A few other IHSSs have been sampled for dioxins although they were not expected contaminants.

4.2.2 Evaluation of Spatial Trends

Surface Soil

As shown in Figure A3.4.1, 2,3,7,8-TCDD (TEQ) (mammal) concentrations exceed the ESL at locations within or near PAC 100-609.

4.2.3 Conclusion

Dioxins may have been formed at RFETS within or near historical IHSSs. Because dioxins are potential contaminants at PAC 100-609, and were detected above the ESL at this location, 2,3,7,8-TCDD (TEQ) (mammal) was identified as ECOPCs and was carried forward into the risk characterization.

5.0 REFERENCES

Shacklette, H.T., and J.G. Boerngen, 1984. Element Concentrations in Soils and Other Surface Materials of the Contiguous United States. Professional Paper 1270. U.S. Geological Survey, Washington, D.C.

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TABLES

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Table A3.2.1

Statistical Distributions and Comparison to Background for Sitewide ERA Surface Soil

Analyte	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Dataset			Sitewide ERA Dataset[a]					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Antimony	**20**	**NONPARAMETRIC**	**0**	**2482**	**NONPARAMETRIC**	**20**	**N/A**	**N/A**	**Yes[a]**
Cadmium	20	NONPARAMETRIC	65	2603	NONPARAMETRIC	36	WRS	1.000	No
Chromium	**20**	**NORMAL**	**100**	**2624**	**NONPARAMETRIC**	**99**	**WRS**	**0.030**	Yes
Copper	**20**	**NONPARAMETRIC**	**100**	**2621**	**NONPARAMETRIC**	**98**	**WRS**	**0.035**	Yes
Mercury	20	NONPARAMETRIC	40	2541	NONPARAMETRIC	49	WRS	1.000	No
Molybdenum	**20**	**NORMAL**	**0**	**2421**	**NONPARAMETRIC**	**47**	**N/A**	**N/A**	**N/A**
Nickel	**20**	**NORMAL**	**100**	**2620**	**NONPARAMETRIC**	**97**	**WRS**	**0.077**	**Yes**
Tin	**20**	**NORMAL**	**0**	**2423**	**NONPARAMETRIC**	**10**	**N/A**	**N/A**	**N/A**
Vanadium	20	NORMAL	100	2622	NONPARAMETRIC	100	WRS	0.434	No
Zinc	20	NORMAL	100	2622	NONPARAMETRIC	100	WRS	0.583	No

[a] Sitewide ERA data exclude background data.

WRS = Wilcoxon Rank Sum

N/A = not applicable; site and/or background detection frequency less than 20%.

Bolded entries indicated analytes retained for further consideration in the next ECOPC selection step.

Table A3.2.2

Summary Statistics for Background and Sitewide ERA Surface Soil[a]

Analyte	Units	Background Dataset					Sitewide ERA Dataset[b]				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Antimony	mg/kg	20	ND	ND	0.279	0.0784	2,482	0.270	348	2.25	7.95
Cadmium	mg/kg	20	0.670	2.30	0.708	0.455	2,603	0.0600	270	0.689	5.66
Chromium	mg/kg	20	5.50	16.9	11.2	2.78	2,624	1.20	210	15.4	13.2
Copper	mg/kg	20	5.20	16	13.0	2.58	2,621	1.70	1,860	21.9	54.5
Mercury	mg/kg	20	0.0900	0.120	0.0715	0.0310	2,541	0.00140	48	0.0670	0.956
Molybdenum	mg/kg	20	N/A	N/A	0.573	0.184	2,421	0.140	19.1	0.984	1.06
Nickel	mg/kg	20	3.80	14	9.60	2.59	2,620	1.90	280	12.3	10.7
Tin	mg/kg	20	N/A	N/A	2.06	0.410	2,423	0.289	161	3.44	8.13
Vanadium	mg/kg	20	10.8	45.8	27.7	7.68	2,622	4.40	5,300	36.5	143
Zinc	mg/kg	20	21.1	75.9	49.8	12.2	2622	4.20	11,900	75.5	257
2,4,6-Trichlorophenol	ug/kg	N/A	N/A	N/A	N/A	N/A	1,180	950	950	260	217
2-Methylnaphthalene	ug/kg	N/A	N/A	N/A	N/A	N/A	1,223	34	12,000	264	396
Benzo(a)pyrene	ug/kg	N/A	N/A	N/A	N/A	N/A	1235	36	43,000	392	1,293
2,3,7,8-TCDD TEQ (Bird)	ug/kg	N/A	N/A	N/A	N/A	N/A	22	4.87E-08	0.126	0.0159	0.0291
2,3,7,8-TCDD TEQ (Mammal)	ug/kg	N/A	N/A	N/A	N/A	N/A	22	4.87E-08	0.0739	0.00821	0.0154
bis(2-ethylhexyl)phthalate	ug/kg	N/A	N/A	N/A	N/A	N/A	1227	29	75,000	401	2,263
Dieldrin	ug/kg	N/A	N/A	N/A	N/A	N/A	468	1.80	92	10.8	9.98
Pentachlorophenol	ug/kg	N/A	N/A	N/A	N/A	N/A	1,180	39	39,000	1,267	1,473
Tetrachloroethene	ug/kg	N/A	N/A	N/A	N/A	N/A	633	0.380	29,000	49.6	1,153
Total Dioxins	ug/kg	N/A	N/A	N/A	N/A	N/A	22	0.0172	1.31	0.261	0.306
Total PCBs	ug/kg	N/A	N/A	N/A	N/A	N/A	845	20.1	12,300	359	1,029

[a] Statistics are computed using one-half the reported value for nondetects.

[b] Sitewide ERA data exclude background data.

N/A = Not available or not applicable.

ND = Data nondetects.

Table A3.4.1

Summary of Element Soil Concentrations Colorado and Bordering States[a]

Analyte	Total Number of Results	Detection Frequency (%)	Range of Detected Values (mg/kg)	Average (mg/kg)[b]	Standard Deviation (mg/kg)[b]
	303	100%	5,000 - 100,000	50,800	23,500
Antimony	84	15%	1.038 - 2.531	0.647	0.378
Arsenic	307	99%	1.224 - 97	6.9	7.64
Barium	342	100%	100 - 3000	642	330
Beryllium	342	36%	1 - 7	0.991	0.876
Boron	342	67%	20 - 150	27.9	19.7
Bromine	85	51%	0.5038 - 3.522	0.681	0.599
Calcium	342	100%	0.055 - 32	3.09	4.13
Carbon	85	100%	0.3 - 10	2.18	1.92
Cerium	291	16%	150 - 300	90	38.4
Chromium	342	100%	3 - 500	48.2	41
Cobalt	342	89%	3 - 30	8.09	5.03
Copper	342	100%	2 - 200	23.1	17.7
Fluorine	264	97%	10 - 1,900	394	261
Gallium	340	99%	5 - 50	18.3	8.9
Germanium	85	100%	0.578 - 2.146	1.18	0.316
Iodine	85	79%	0.516 - 3.487	1.07	0.708
Iron	342	100%	3,000 - 100,000	21,100	13,500
Lanthanum	341	66%	30 - 200	39.8	28.8
Lead	342	93%	10 - 700	24.8	41.5
Lithium	307	100%	5 - 130	25.3	14.4
Magnesium	341	100%	300 - 50,000	8,630	6,400
Manganese	342	100%	70 - 2,000	414	272
Mercury	309	99%	0.01 - 4.6	0.0768	0.276
Molybdenum	340	4%	3 - 7	1.59	0.522
Neodymium	256	23%	70 - 300	47.1	31.7
Nickel	342	96%	5 - 700	18.8	39.8
Niobium	335	63%	10 - 100	11.4	8.68
Phosphorus	249	100%	40 - 4497	399	397
Potassium	341	100%	1,900 - 63,000	18,900	6,980
Rubidium	85	100%	35 - 140	75.8	25
Scandium	342	85%	5 - 30	8.64	4.69
Selenium	309	81%	0.1023 - 4.3183	0.349	0.415
Silicon	85	100%	149,340 - 413,260	302,000	61,500
Sodium	335	100%	500 - 70,000	10,400	6,260
Strontium	342	100%	10 - 2,000	243	212
Sulfur	85	16%	816 - 47,760	1,250	5,300
Thallium	76	100%	2.45 - 20.79	9.71	3.54
Tin	85	96%	0.117 - 5.001	1.15	0.772
Titanium	342	100%	500 - 7,000	2,290	1,350
Uranium	85	100%	1.11 - 5.98	2.87	0.883
Vanadium	342	100%	7 - 300	73	41.7
Ytterbium	330	99%	1 - 20	3.33	2.06
Yttrium	342	98%	10 - 150	26.9	18.1
Zinc	330	100%	10 - 2,080	72.4	159
Zirconium	342	100%	30 - 1,500	220	157

[a] Based on data from Shacklette and Boerngen 1984 for the states of Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming.

[b] One-half the detection limit used as proxy value for nondetects in computation of the mean and standard deviation.

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FIGURES

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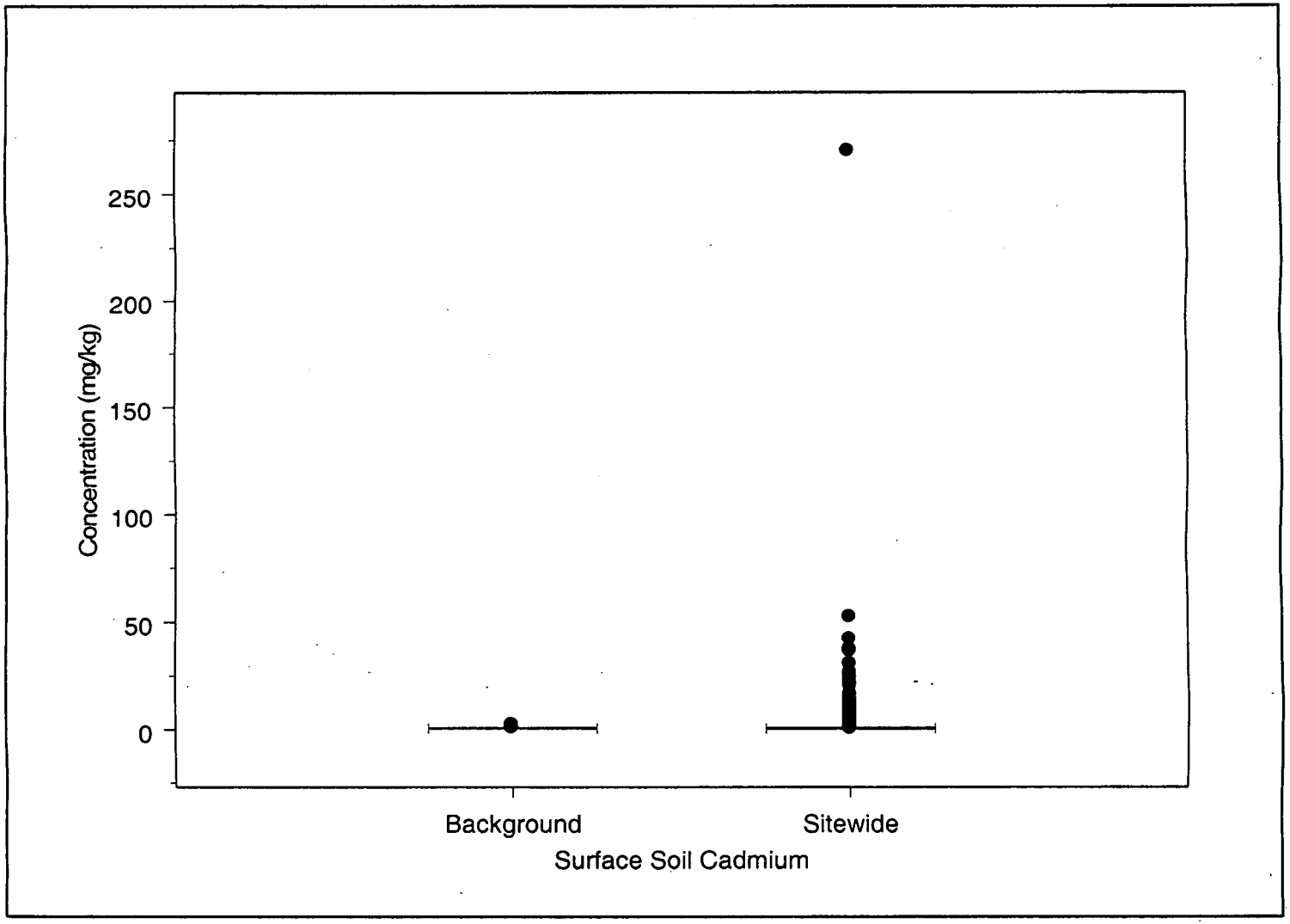
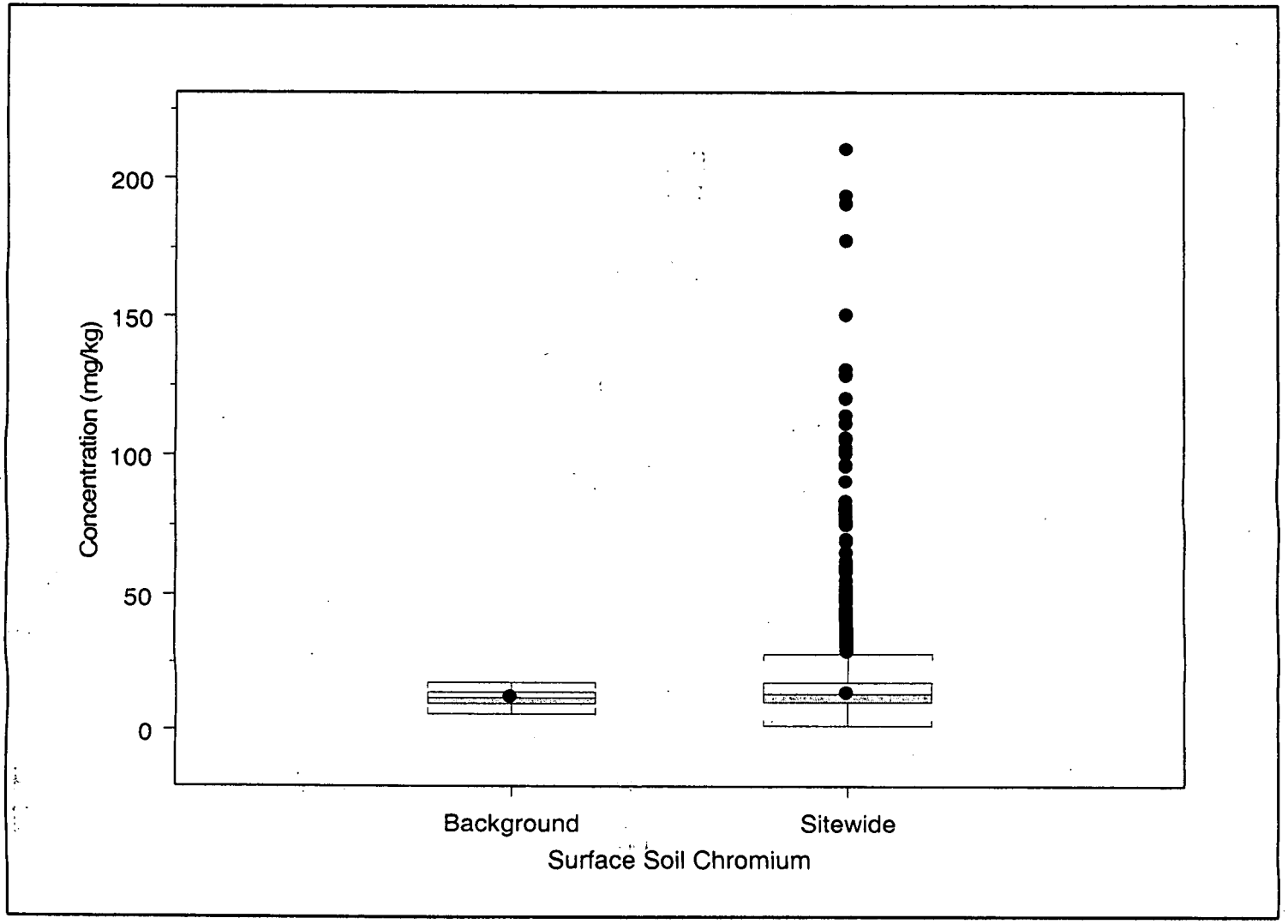
Figure 3.2.1
Sitewide Surface Soil Box Plots for Cadmium



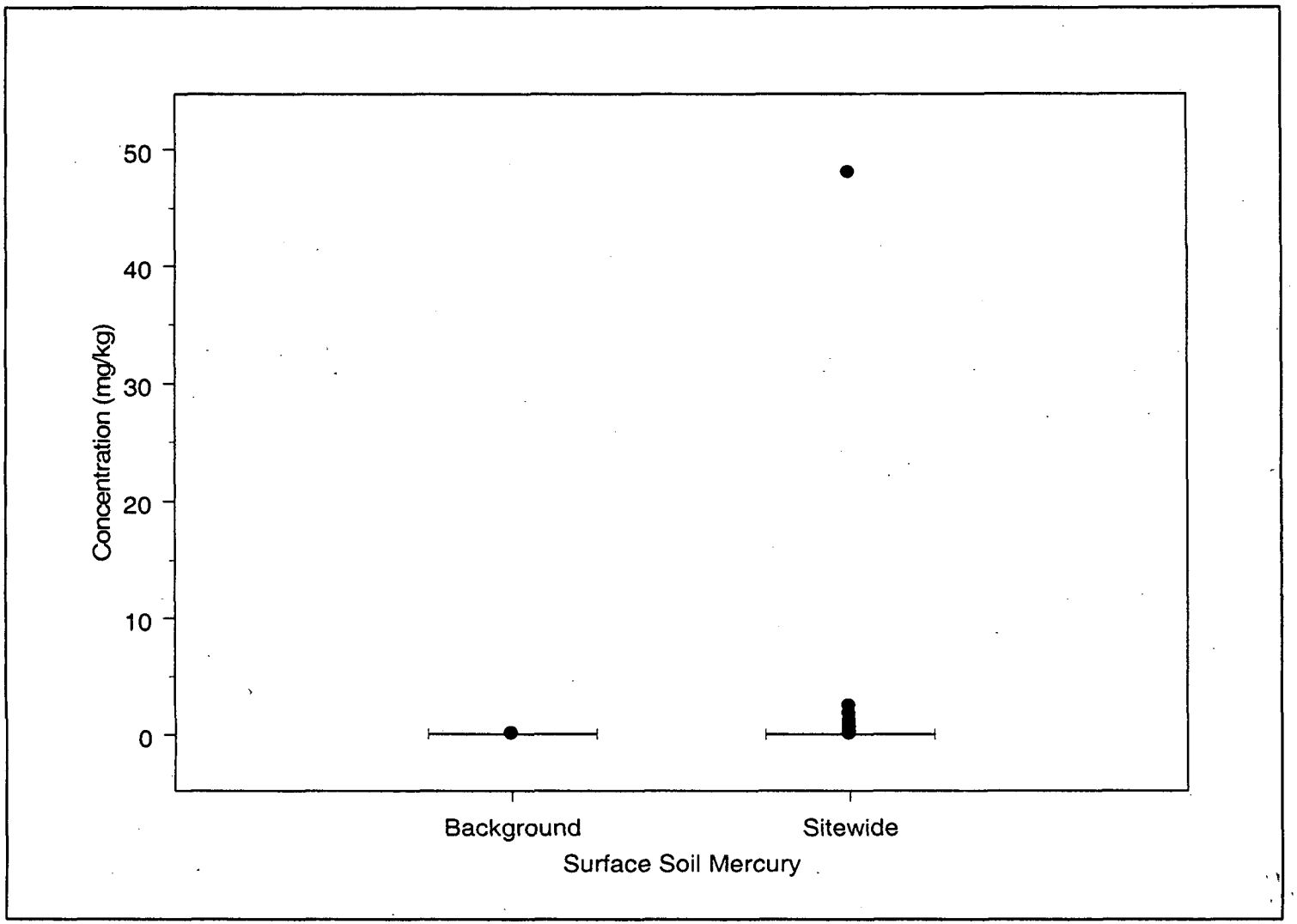
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 5.2.2
Sitewide Surface Soil Box Plots for Chromium



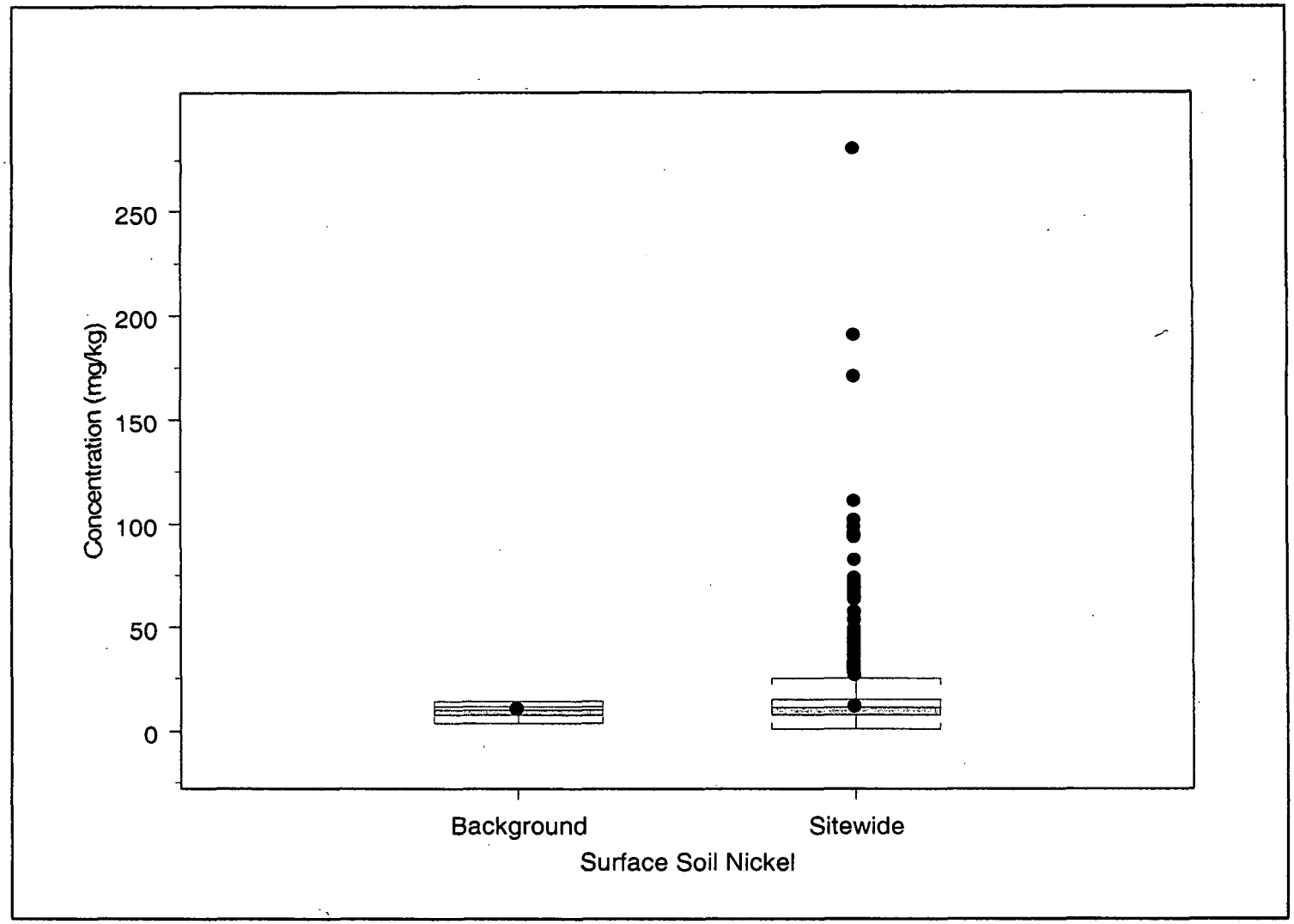
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 5.2.3
Sitewide Surface Soil Box Plots for Mercury



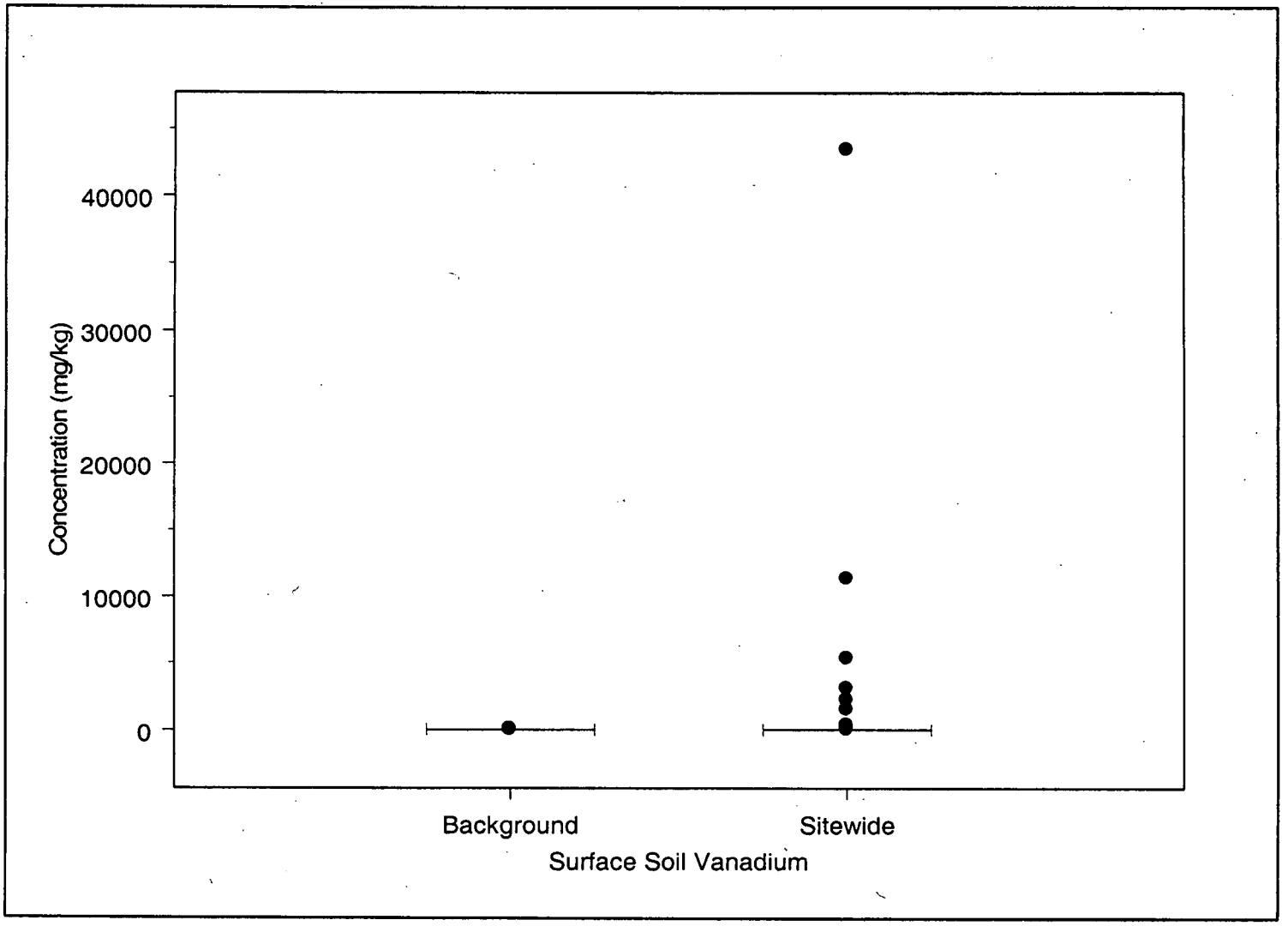
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.4
Sitewide Surface Soil Box Plots for Nickel



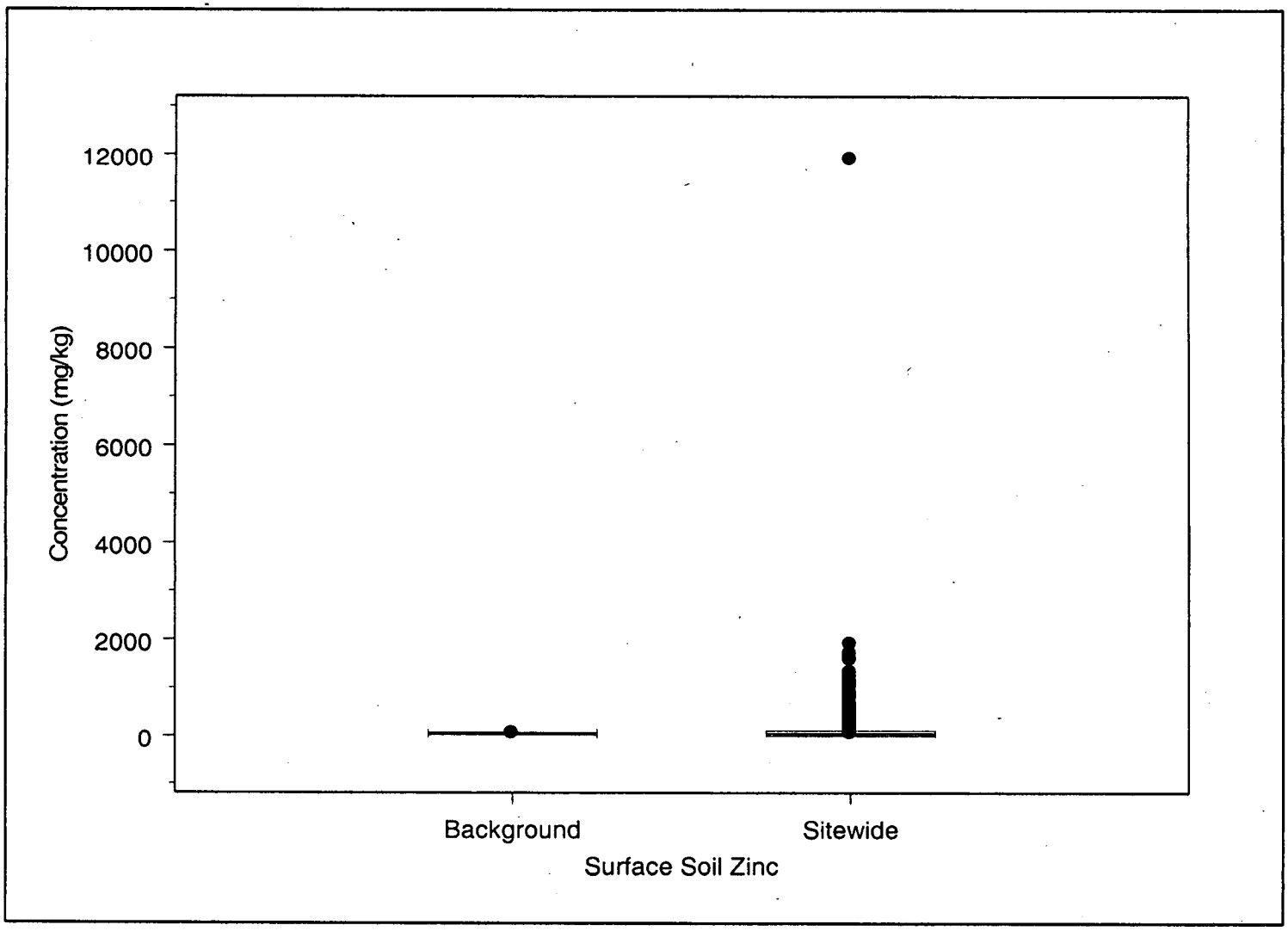
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.5
Sitewide Surface Soil Box Plots for Vanadium



Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

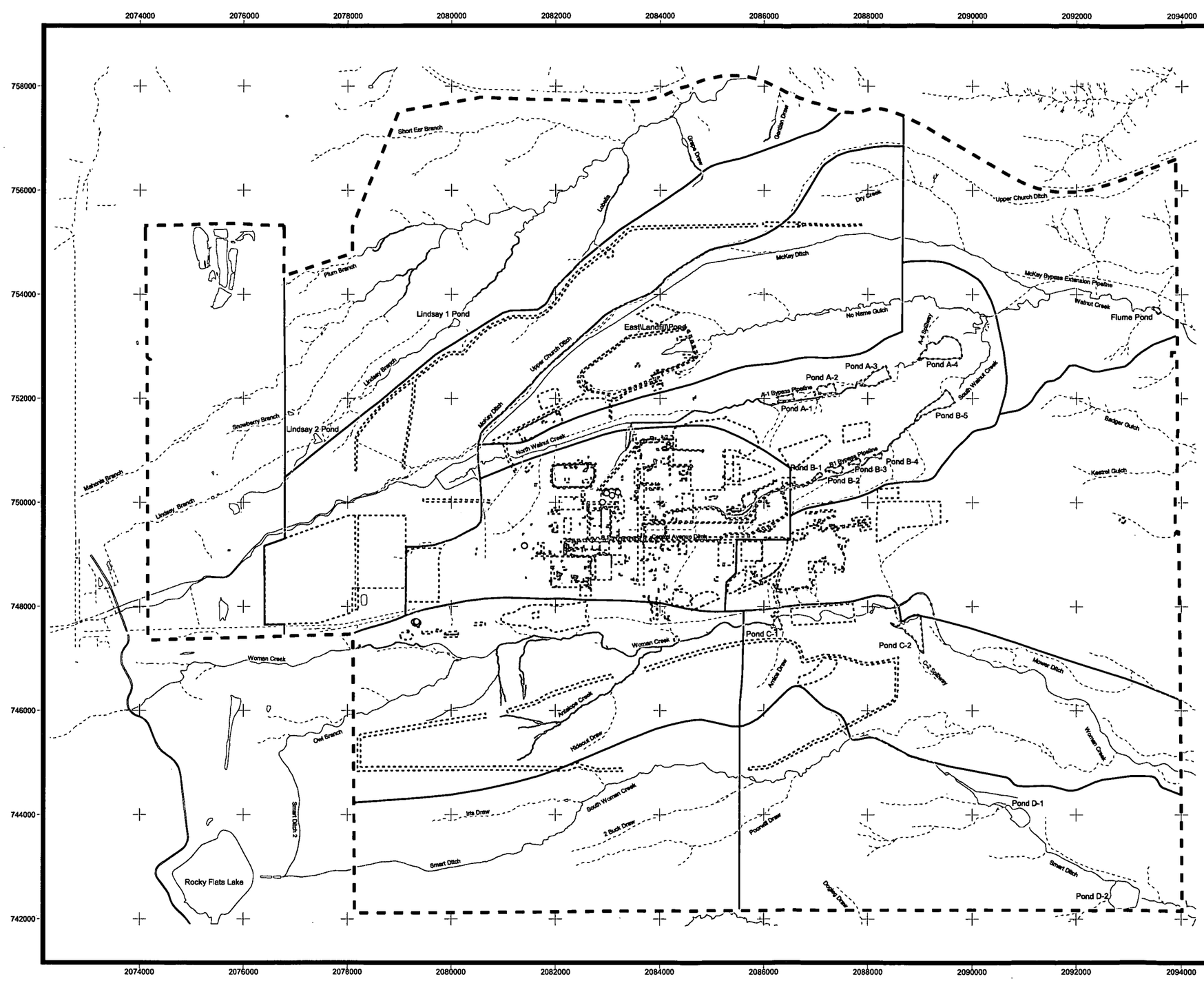
Figure 5.2.6
Sitewide Surface Soil Box Plots for Zinc



Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.4.1

2,3,7,8-TCDD TEQ (Mammal) Concentrations in Sitewide Surface Soil (Non-PMJM)



KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 0.004 ug/kg
3 x Min. Non-PMJM ESL = 0.012 ug/kg

Standard Map Features

- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Ephemeral stream
- Intermittent stream
- Perennial stream
- Site boundary

N
W E
S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\FY2005\CRA\ProfessionalJudgement\FINAL-profjudgment.apr

COMPREHENSIVE RISK ASSESSMENT

WIDE-RANGING ECOLOGICAL RECEPTORS

VOLUME 15A: ATTACHMENT 4

Risk Assessment Calculations

TABLE OF CONTENTS

1.0 ECOLOGICAL RISK ASSESSMENT TABLES

TABLES

Table A4.2.1
Intake and Exposure Estimates for Nickel - Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -2.224+0.748(lnCs)	4.73	lnCm = -0.2462 + 0.4658(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
19.3	Tier 1 95th UTL	0.99	91.3	3.10	0.015	
13.2	Tier 1 95th UCL	0.74	62.4	2.60	0.009	
13.0	Tier 2 95th UTL	0.74	61.6	2.58	0.015	
12.6	Tier 2 95th UCL	0.72	59.8	2.55	0.009	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Coyote - Generalist						
Tier 1 95th UTL	N/A	3.42E-01	3.49E-02	1.45E-02	1.20E-03	3.93E-01
Tier 1 95th UCL	N/A	2.34E-01	2.92E-02	9.89E-03	7.20E-04	2.74E-01
Tier 2 95th UTL	N/A	2.31E-01	2.91E-02	9.77E-03	1.20E-03	2.71E-01
Tier 2 95th UCL	N/A	2.24E-01	2.87E-02	9.48E-03	7.20E-04	2.63E-01
Coyote - Insectivore						
Tier 1 95th UTL	N/A	1.37E+00	N/A	8.11E-03	1.20E-03	1.38E+00
Tier 1 95th UCL	N/A	9.36E-01	N/A	5.54E-03	7.20E-04	9.42E-01
Tier 2 95th UTL	N/A	9.24E-01	N/A	5.47E-03	1.20E-03	9.31E-01
Tier 2 95th UCL	N/A	8.97E-01	N/A	5.31E-03	7.20E-04	9.03E-01

N/A = Not applicable.

Table A4.2.2
Wide-Ranging Receptor Hazard Quotients for Surface Soil - Nickel

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)			Hazard Quotients		
		NOAEL	Threshold	LOAEL	NOAEL	Threshold	LOAEL
Nickel (Default Exposure)							
Coyote - Generalist							
Tier 1 95th UTL	3.93E-01	1.33E-01	N/A	1.33E+00	**3**	N/A	0.3
Tier 1 95th UCL	2.74E-01	1.33E-01	N/A	1.33E+00	**2**	N/A	0.2
Tier 2 95th UTL	2.71E-01	1.33E-01	N/A	1.33E+00	**2**	N/A	0.2
Tier 2 95th UCL	2.63E-01	1.33E-01	N/A	1.33E+00	**2**	N/A	0.2
Coyote - Insectivore							
Tier 1 95th UTL	1.38E+00	1.33E-01	N/A	1.33E+00	**10**	N/A	**1**
Tier 1 95th UCL	9.42E-01	1.33E-01	N/A	1.33E+00	**7**	N/A	0.7
Tier 2 95th UTL	9.31E-01	1.33E-01	N/A	1.33E+00	**7**	N/A	0.7
Tier 2 95th UCL	9.03E-01	1.33E-01	N/A	1.33E+00	**7**	N/A	0.7

N/A = Not applicable.
Bold = Hazard quotients>1.

Table A4.2.3

Intake and Exposure Estimates for 2,3,7,8-TCDD TEQ (Mammal) - Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.22	lnCi = 3.53 + 1.2(lnCs)	lnCsm = 0.8113 + .0993(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
7.4E-05	Tier 1 95th UTL	0.000016	0.000376	0.000065	0	
1.6E-05	Tier 1 95th UCL	0.000004	0.000061	0.000012	0	
1.1E-05	Tier 2 95th UTL	0.000002	0.000040	0.000008	0	
8.4E-06	Tier 2 95th UCL	0.000002	0.000028	0.000006	0	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Coyote - Insectivore						
Tier 1 95th UTL	N/A	5.64E-06	N/A	3.10E-08	0.00E+00	5.67E-06
Tier 1 95th UCL	N/A	9.18E-07	N/A	6.83E-09	0.00E+00	9.25E-07
Tier 2 95th UTL	N/A	5.94E-07	N/A	4.75E-09	0.00E+00	5.98E-07
Tier 2 95th UCL	N/A	4.15E-07	N/A	3.53E-09	0.00E+00	4.19E-07

N/A = Not applicable.

Table A4.2.4

Wide-Ranging Receptor Hazard Quotients for Surface Soils - 2,3,7,8-TCDD TEQ (Mammal)

Receptor/ EPC Statistic	Total Intake (mg/kg BW-day)	TRV (mg/kg BW-day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Default Exposure					
Coyote - Insectivore					
Tier 1 95th UTL	5.67E-06	1.00E-06	1.00E-05	**6**	0.6
Tier 1 95th UCL	9.25E-07	1.00E-06	1.00E-05	0.9	0.09
Tier 2 95th UTL	5.98E-07	1.00E-06	1.00E-05	0.6	0.06
Tier 2 95th UCL	4.19E-07	1.00E-06	1.00E-05	0.4	0.04

Bold = Hazard quotients>1.

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Chemical-Specific Uncertainty Analysis

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ACRONYMS AND ABBREVIATIONS

BAF	Bioaccumulation Factors
BW	body weight
CRA	Comprehensive Risk Assessment
ECOPC	ecological contaminant of potential concern
EcoSSL	Ecological Soil Screening Level
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESL	ecological screening level
HQ	hazard quotient
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effect concentration
mg/kg	milligrams per kilogram
mg/kg/BW/day	milligram per kilogram per receptor body weight per day
NOAEL	no observed adverse effect level
PMJM	Preble's meadow jumping mouse
PRC	PRC Environmental Management, Inc
RFETS	Rocky Flats Environmental Technology Site
TRV	toxicity reference value
UCL	upper confidence limit
UTL	upper tolerance limit
UWNEU	Upper Walnut Exposure Unit

1.0 INTRODUCTION

One potential limitation of the HQ approach is that calculated HQ values may sometimes be uncertain due to simplifications and assumptions in the underlying exposure and toxicity data used to derive the HQs. Where possible, this risk assessment provides information on two potential sources of uncertainty, described below.

- **Bioaccumulation Factors (BAFs).** For wildlife receptors, concentrations of contaminants in dietary items were estimated from surface soil using uptake equations. When the uptake equation was based on a simple linear model (e.g., Ctissue = BAF * Csoil), the default exposure scenario used a high-end estimate of the BAF (the 90th percentile BAF). However, the use of high-end BAFs may tend to overestimate tissue concentrations in some dietary items. If necessary, in order to estimate more typical tissue concentrations, an alternate exposure scenario calculated total chemical intake using a 50th percentile (median) BAF. The use of the median BAF is consistent with the approach used in the ecological soil screening level (EcoSSL) guidance (EPA 2005).
- **Toxicity Reference Values (TRVs).** The CRA Methodology utilized an established hierarchy to identify the most appropriate default TRVs for use in the ECOPC selection. However, in some instances, the default TRV selected may be overly conservative with regard to characterizing population-level risks. The determination of whether the default TRVs are thought to yield overly conservative estimates of risk is addressed in the uncertainty sections below on a chemical-by-chemical basis. If LOAEL HQs greater than 1 were calculated using the default HQ calculations and an alternate TRV is identified, the chemical-specific uncertainty sections provide a discussion of why the alternate TRV is thought to be appropriate to provide an alternative estimate of toxicity (e.g., endpoint relevance, species relevance, data quality, chemical form, etc.), and HQs were calculated using both default and alternate TRVs.

The influences of each of these uncertainties on the calculated HQs are discussed for each ECOPC in the following subsections.

1.1 Nickel

Bioaccumulation Factors

There are several important uncertainties associated with the intake and HQ calculations for vertebrate receptors. Nickel has two types of bioaccumulation factors used in the intake calculations. For the soil-to-plant and soil-to-small mammal BAFs, regression equations were used to estimate tissue concentrations. Confidence placed in these values is high; however, uncertainty is unavoidable when using even high quality models to predict tissue concentrations. In cases without available measurements of tissue concentrations, regression-based models are generally the best available predictor of tissue concentrations. However, the regression-based BAFs may still overestimate or underestimate tissue concentrations of nickel to an unknown degree.

The soil-to-invertebrate BAF used to estimate invertebrate tissue concentrations is based on a screening-level upper bound (90th percentile) BAF presented in Sample et al. (1998a). This value provides a conservative estimate of uptake from soils to invertebrate tissues. This conservative estimate may serve to overestimate nickel concentrations in invertebrate tissues. For this reason, the median BAF presented in the same document (Sample et al. 1998b) can be used as an alternative BAF to estimate invertebrate tissue concentrations.

It is unclear whether the use of median BAFs reduces the uncertainty involved in the estimation of invertebrate tissue concentrations, but the likelihood of overestimation of risks is reduced.

Toxicity Reference Values

Uncertainty is also present in the TRVs used in the default HQ calculations for nickel.. The NOAEL TRV used to calculate the ESL was estimated from the LOAEL TRV in the CRA Methodology by dividing by a factor of 10. The LOAEL TRV for mammals (1.33 mg/kg/BW/day) is based on pup mortality in rats. Given that the LOAEL TRV is 10 times the NOAEL TRV, a back-calculated soil concentration using the LOAEL TRV equals 3.8 mg/kg. This concentration is equal to the minimum detected concentration of nickel in background soils and would be exceeded by 19 of the 20 site-specific background soil concentrations. Because risks to ecological receptors are not generally expected in background areas, this indicates that the default TRVs used to calculate risks for mammals in general are too conservative and risks are over-predicted when using these TRVs.

The CRA Methodology prescribed a hierarchy of TRV sources from which TRVs could be identified and used without modification. TRVs were selected first from EPA EcoSSL guidance (EPA 2003) from which no nickel TRVs were available. The second Tier TRV source was PRC (1994), from which the LOAEL TRV was obtained and the NOAEL TRV was estimated. Because this value appears to be overly-conservative, the third Tier TRV source (Sample et al. 1996) was reviewed for a usable TRV. Sample et al. (1996) presents TRVs for mammals.

The use of these alternative risk calculations serves to provide an estimate of risk using a reasonable, yet reduced, level of conservatism for all receptors.

Background Risks

Nickel was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the coyote (generalist and insectivore) were calculated using both the UCL and UTL of background soils and default NOAEL and LOAEL TRVs. NOAEL HQs greater or equal to 1 for all receptors were calculated using both the UCL and UTL background

surface soil concentrations. LOAEL HQs were less than 1 for both coyote receptors. These results indicate that risks calculated using the default exposure model and TRVs were not overly conservative for the coyote receptors

1.2 Dioxin (Total)

Bioaccumulation Factors

The soil-to-invertebrate BAF used to predict invertebrate concentrations was developed using a regression equation to estimate tissue concentrations. Confidence placed in these values is high. Uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. However, in cases without available measurements of tissue concentrations, regression-based models are the best available predictor of tissue concentrations. The regression-based BAF may overestimate or underestimate tissue concentrations of total dioxins to an unknown degree.

Toxicity Reference Values

For mammalian receptors, dioxin TRVs were obtained from Sample et al (1996). The study evaluated fertility and neonatal survival among rats over 3 generations. The study identified both a NOAEL and a LOAEL and confidence in the values was rated as high. However, there is a certain degree of uncertainty in all laboratory derived TRVs and they may overestimate or underestimate risk to an unknown degree.

Background Risk Calculations

Dioxins were not analyzed for in background surface soils. Therefore, background risks were not calculated for dioxins in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

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COMPREHENSIVE RISK ASSESSMENT

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CRA Analytical Data Set CD